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GROUNDWATER MONITORING WORKPLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

UNIT IDENTIFICATION CODE: N62604
CONTRACT NO. N62467-89-D-0317/128

JUNE 1997

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

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GROUNDWATER MONITORING WORKPLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

Unit Identification No.: N62604

Contract No.: N62467-89-D-0317/128

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June 1997

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Gulfport, Mississippi

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
AO	Administrative Order
ASTM	American Society for Testing and Materials
bls	below land surface
CPT	cone penetrometer testing
2,4-D	2,4-dichlorophenoxyacetic acid
DDT	dichlorodiphenyltrichloroethane
DM	data manager
DO	dissolved oxygen
DPT	direct-push technology
DQOs	data quality objectives
FID	flame ionization detector
GIS	geographic information system
GWMP	groundwater monitoring plan
HAZWRAP	Hazardous Waste Remedial Action Program
HO	herbicide orange
IAS	Initial Assessment Study
IDW	investigative-derived waste
IR	Installation Restoration
MEK	methyl ethyl ketone
MK	Morrison Knudson
MS/MSD	matrix spike and matrix spike duplicate
MSDEQ	Mississippi State Department of Environmental Quality
NCBC	Naval Construction Battalion Center
NCF	Naval Construction Force
NEESA	Naval Energy and Environmental Support Activity
ORP	oxidation/reduction potential
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCBs	polychlorinated biphenyl
2,3,7,8-PeCDD	2,3,7,8-pentachloro-p-dioxin
ppb	part per billion
ppm	parts per million
ppq	parts per quadrillion
ppt	parts per trillion
PVC	polyvinyl chloride

QA/QC	quality assurance and quality control
QC	quality control
RPD	relative percent difference
SAP	sampling and analysis plan
SOUTHNAV-FACENGCOM	Southern Division, Naval Facilities Engineering Command
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
TCDD	tetrachlorodibenxo-p-dioxin
TCLP	toxicity characteristic leachate procedure
TDS	total dissolved solids
TEF	toxicity equivalency factor
TEQ	toxicity equivalence quotient
TOC	total organic carbon
TSS	total suspended solids
USAF	U.S. Air Force
USEPA	U.S. Environmental Protection Agency

CHAPTER 1.0

1.0 INTRODUCTION

Under contract to the U.S. Department of the Navy, Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), this Groundwater Monitoring Workplan was prepared for the Naval Construction Battalion Center (NCBC) in Gulfport, Mississippi. This workplan was prepared under the Comprehensive Long-term Environmental Action, Navy, Contract No. N62467-89-D-0317, Contract Task Order No. 128.

On February 14, 1996, Administrative Orders (AOs) No. 3193-96 and No. 3194-96 were issued to the U.S. Navy and U.S. Air Force (USAF), respectively, by the Mississippi State Department of Environmental Quality (MSDEQ) as a result of environmental issues at NCBC Gulfport. These AOs contained identical requirements for the Navy and USAF. These orders require a Groundwater Monitoring Workplan to be submitted to MSDEQ. This workplan describes the field investigation to be performed to identify and delineate groundwater impacted by dioxin and dioxin-related contaminants associated with the storage and handling of herbicide orange (HO). This workplan will also include the determination of the potentiometric surface for the base. The primary chemicals of potential concern are HO and its impurity, dioxin.

The purpose of this workplan is to guide the efforts to identify and delineate groundwater containing dioxin within the boundaries of NCBC Gulfport that relate to the storage and handling of HO. The following sections provide the objectives, purpose, and scope of the Groundwater Monitoring Workplan; site history; a conceptual model to facilitate an understanding of the existing conditions at the site; and an overview of the organization of the workplan.

The word "dioxin" will be used often in this document. Unless otherwise specified, such as the individual congeners tetrachlorodibenxo-p-dioxin (TCDD) or OCDD, "dioxin" will be referring to the toxicity equivalence quotient (TEQ) total of the dioxin and furan congeners with chlorine atoms at the 2,3,7,8 molecular positions.

<u>1.1 OBJECTIVES AND SCOPE OF THE GROUNDWATER MONITORING WORKPLAN</u>. The main objective of this workplan is to identify and delineate groundwater that may contain dioxin and dioxin related compounds associated with Sites 4,5, and 8 at NCBC Gulfport, as well as the installation of downgradient monitoring wells at Sites 1, 2, 3, and 7. As part of the process to identify and delineate these compounds in the groundwater, the basewide potentiometric surface (groundwater flow direction) and the interaction of surface water and groundwater will be evaluated. This workplan will address groundwater that became contaminated by dioxin as a result of the storage and handling of HO on the base.

The field investigation to determine the limits of dioxin-contaminated groundwater will be phased in to limit the number of samples and permanent monitoring wells and, therefore, reduce the short-term and long-term costs of this program. The objective of the first phase is to delineate and characterize dioxin-contaminated groundwater at Sites 4, 5, and 8 and determine the best locations for downgradient monitoring wells at Sites 1, 2, 3, and 7. The first phase will consist of modified cone penetrometer testing (CPT) to collect groundwater samples at Sites 4, 5, and 8. These three sites were selected for CPT investigation because of known or suspected presence of dioxin in the soil or groundwater. The CPT characterization study at Sites 1, 2, 3, and 7 will be focused on downgradient groundwater sample collection prior to installation of permanent groundwater monitoring wells because there is no evidence to suggest a CPT study is warranted.

The results of the first phase of the work will be used to refine the conceptual models and focus the installation of permanent monitoring wells in second phase of these groundwater monitoring activities. The objectives of the second phase of work will be to install and sample permanent monitoring wells in locations that will (1) adequately characterize the groundwater conditions at Sites 4, 5, and 8 and (2) provide downgradient monitoring wells at Sites 1, 2, 3, and 7.

1.2 BASE HISTORY. NCBC Gulfport is located in the western part of Gulfport, Mississippi, in Harrison County, in the southeastern corner of the state, approximately 2 miles north of the Gulf of Mexico (Figure 1-1). The base is located on the north side of Gulfport (Figure 1-2) approximately 1 mile from Highway 49.

The primary mission of NCBC Gulfport is the support of four battalions of the Naval Construction Force (NCF) and the storage and maintenance of prepositioned War Reserve Material Stock. The NCF support consists of both homeport services and deployed support. Approximately 4,000 military and 1,600 civilian personnel are assigned to or employed by the base. The base occupies 1,100 acres and has an elevation averaging 30 feet above sea level (Figure 1-3), with the only significant exception being the linear piles of bauxite stored on the surface. These bauxite piles range from 30 to 40 feet above the grade of the base. Surface soils are primarily sand to sandy loam with minor clays (Hazardous Waste Remedial Action Program [HAZWRAP], 1991).

From 1968 through 1977, about 23 acres of the base (Site 8) were used for storage and handling of approximately 850,000 gallons of HO in 55-gallon drums (Figure 1-4). Spills and leaks of HO occurred during that period in the area later known as Site 8 (Areas A, B, and C, Figure 1-4). The magnitude of the release of HO and dioxin was investigated in 1977 and was known as the Initial HO Monitoring Program (Occupational and Environmental Health Laboratory, 1979). Followup investigations in 1986 and 1987 delineated the horizontal and vertical extent of dioxin in soil to 1 part per billion (ppb). The delineation work at Site 8 was followed by full-scale incineration of the soils contaminated above 1 ppb. The incineration was completed in 1988, and the resulting ash was stored in piles on Area A of Site 8 (HAZWRAP, 1991).

Damaged drums of HO may have been removed from Site 8 to the landfills now known as Sites 4 and 5. Little documentation actually exists regarding the disposal practices at these sites, so these sources come mainly from interviews with previous employees. The only quantifiable confirmation is the detection of dioxin in a monitoring well at Site 4, although this result does not conclusively indicate that HO was disposed of in that landfill.

1.3 REGULATORY SETTING. This workplan was initiated following the issuance of the AO by MSDEQ on February 14, 1996. The direction of the AO was clarified by

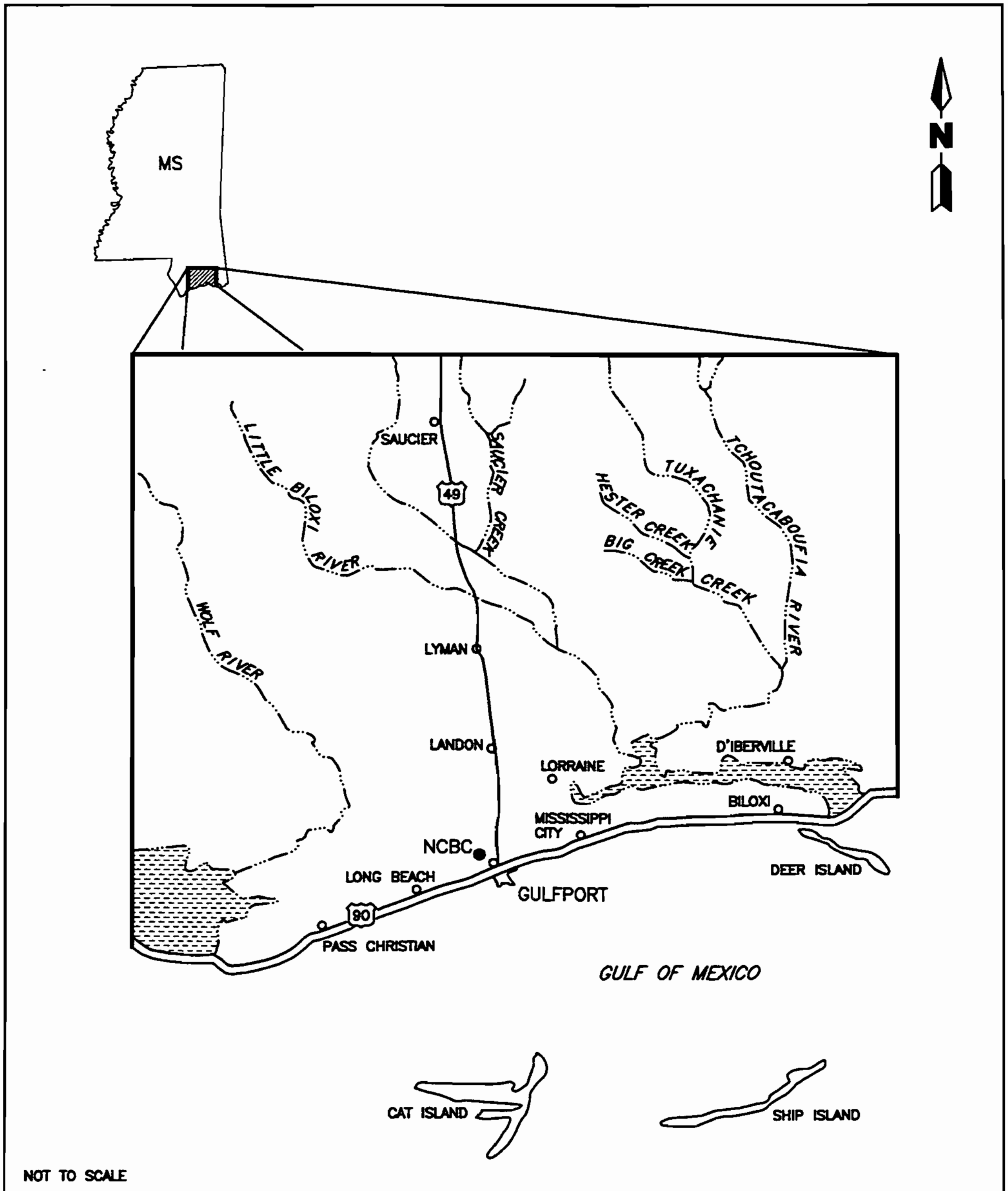

FIGURE 1-1

LOCATION MAP

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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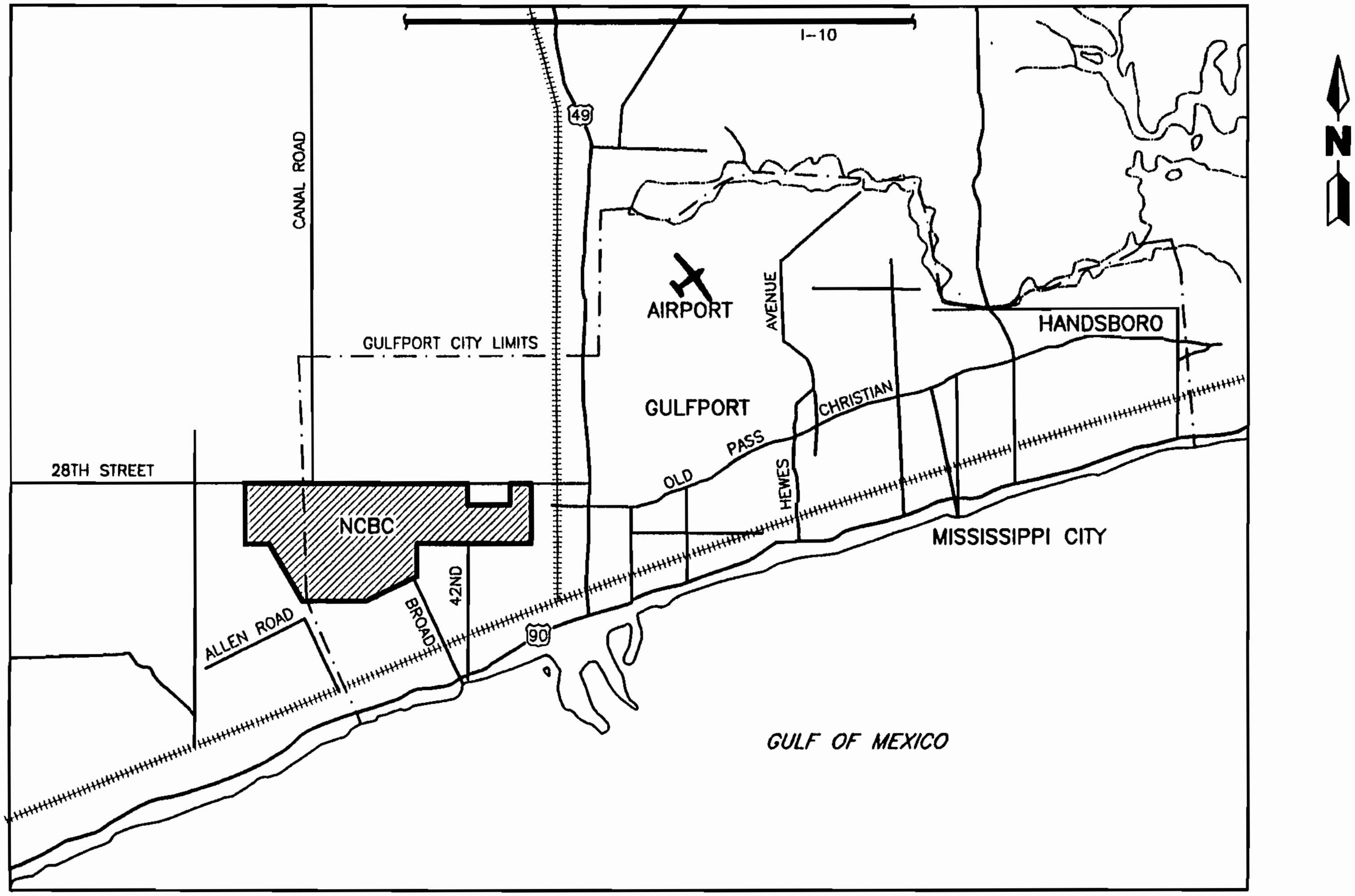

NOT TO SCALE

FIGURE 1-2

VICINITY MAP

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

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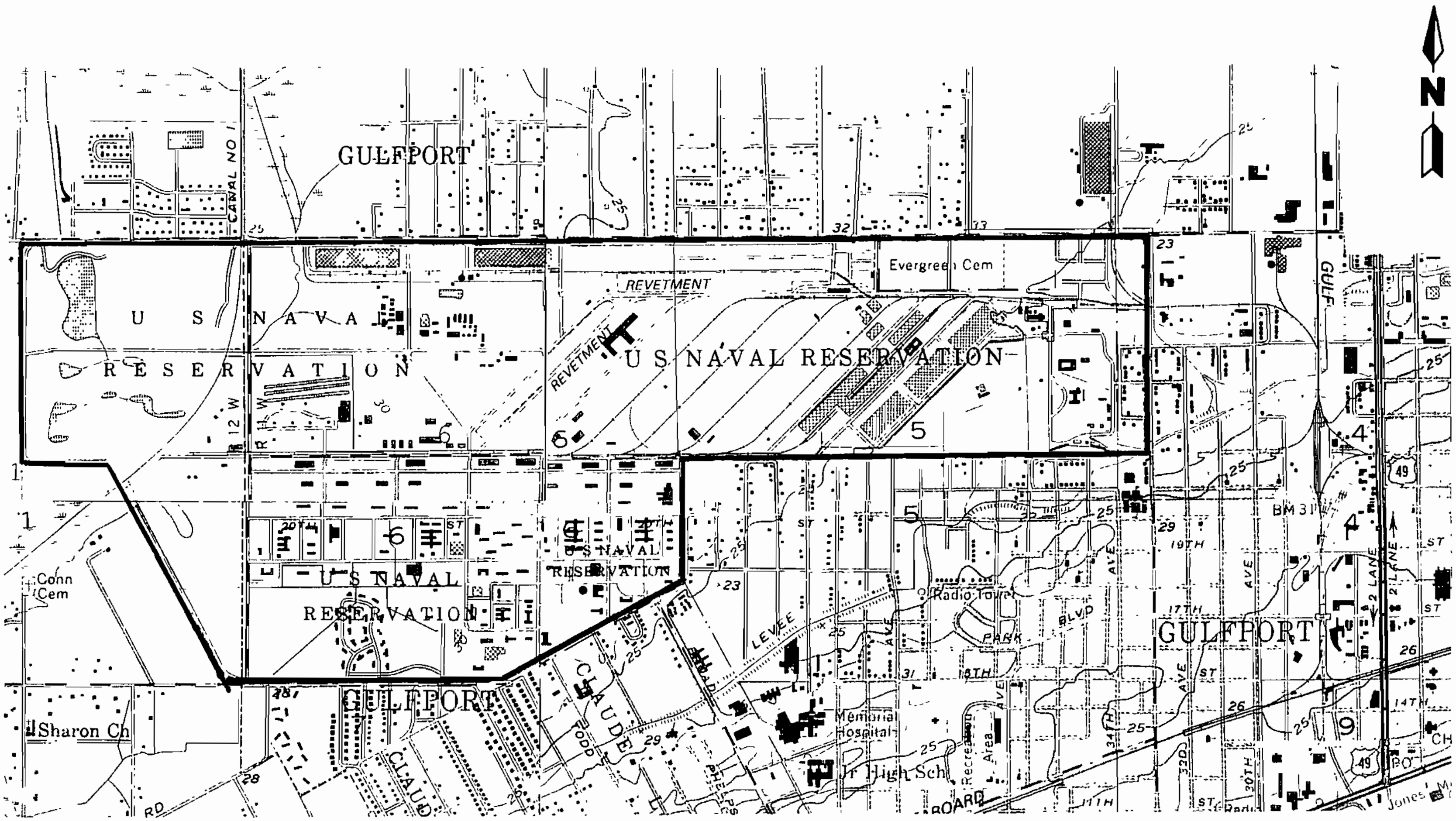

SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES GULFPORT NW, GULFPORT NORTH, PASS CHRISTIAN AND GULFPORT SOUTH MISSISSIPPI QUADS.

0 1000 2000
SCALE: 1" = 2000'

FIGURE 1-3

TOPOGRAPHIC MAP OF SITE VICINITY

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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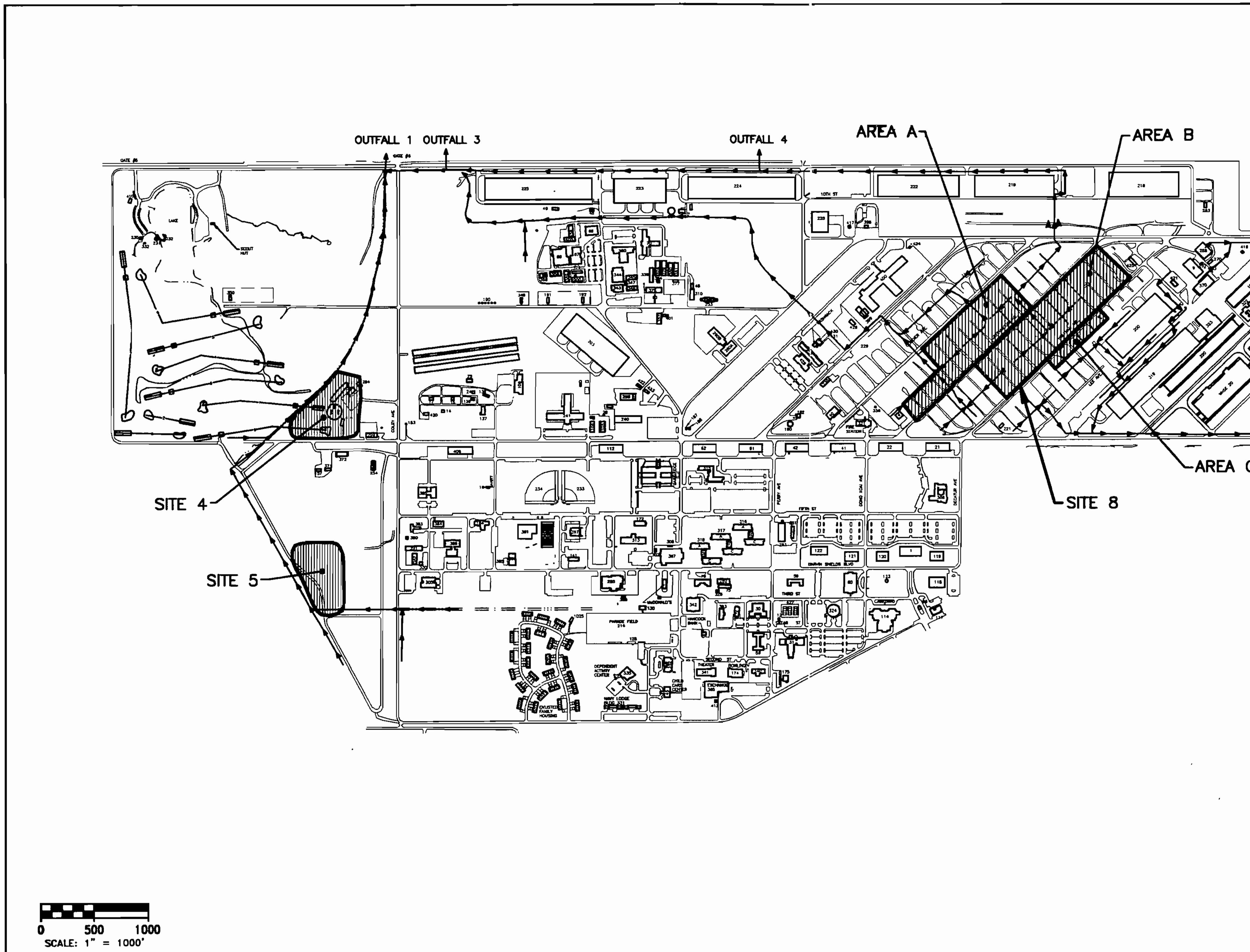

FIGURE 1-4

LOCATION OF FORMER HERBICIDE ORANGE STORAGE AREAS

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

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MSDEQ in a meeting on March 21, 1996. In that meeting, it was determined that the AO would address dioxin and the constituents of HO. Additionally, "onsite" was defined as "onbase" and "offsite" was defined as "offbase." The groundwater monitoring portion of the AO calls for the delineation of dioxin and dioxin-related constituents related to Sites 4, 5, and 8 and downgradient wells at Sites 1, 2, 3, and 7. The order also calls for the definitive determination of groundwater flow for the entire base. This Groundwater Monitoring Workplan (GWMP) will also provide groundwater hydraulic data to support the assessment of groundwater flow at NCBC Gulfport.

1.4 PREVIOUS INVESTIGATIONS. A comprehensive listing and description of previous HO investigations that have taken place on or off the base can be reviewed in the companion documents: Onsite Delineation Workplan (ABB-ES, 1996b) and Offsite Delineation (ABB-ES, 1996c). Therefore, discussions of previous investigations in this workplan will be restricted to the two most recent investigations.

Basewide Sampling. In 1995, ABB-ES (ABB-ES, 1995a) reported on an investigation of surface water and sediment samples at major outfalls and onflows around NCBC. Groundwater samples from all existing monitoring wells at Installation Restoration sites were collected as well. The results of this study indicated the following.

- Dioxin was detected in the sediment samples collected along Outfalls 1 (0.2 parts per trillion [ppt]), 3 (150 ppt), and 4 (0.8 ppt) and Onflow 1 (74 ppt).
- Dioxin was detected in a groundwater sample from at least one monitoring well from all sites. At Site 4, GPT-4-3 had a result of 34.1 parts per quadrillion (ppq), which exceeded the regulatory limit.
- Dioxin was detected at up to 1.2 ppq in surface water samples.
- Sediment-containing dioxin is likely migrating offbase through Outfalls 1, 3, and 4.

Actual confirmation of dioxin levels in the groundwater will require a thorough review of past disposal practices as well as a definitive analysis of the types of dioxin congeners that are present, which will be included in this GWMP and groundwater monitoring activities.

Site 8 Hydrogeologic Assessment. A hydrogeologic assessment at Site 8 was performed in 1994 and 1995 (ABB-ES, 1994a, 1995b, 1995c, 1995d, 1995e, and 1995f) as an addendum to the Versar (1990) sampling and analysis plan (SAP) to determine the impact of HO storage on groundwater. Quarterly groundwater samples were collected from 4 monitoring wells along with 10 samples of ash. Below are findings from these monitoring and sampling activities.

- Ash sample results for TCDD ranged from nondetect to approximately 70 ppt, although toxicity characteristic leaching procedure (TCLP) results on the samples with highest results were less than 3 ppt.

- Groundwater flow across Site 8 is generally to the west-northwest.
- TCDD was detected in groundwater samples collected from shallow monitoring wells at concentrations up to 60 ppq, which is above the maximum contaminant level of 30 ppq.
- TCDD concentrations fluctuated with groundwater levels. For example, during periods of higher groundwater elevations at monitoring well GPT-A-2, TCDD TEQs were approximately 60 ppq and during periods of lower groundwater elevations, TCDD TEQs were 0.15 ppq.

The results from this effort were used in the Delisting Petition Addendum (ABB-ES, 1996d). The hydrogeologic assessment did confirm the presence of dioxin-contaminated groundwater, which occurred as a result of the storage and handling of HO at Site 8. The dioxin congeners discovered in the groundwater at Site 8 are proportionally similar to those found in HO. The extent of groundwater contamination was not the objective of the hydrogeologic investigation. The extent of groundwater contamination will be addressed in this GWMP.

1.5 WORKPLAN ORGANIZATION. This GWMP is organized into five chapters, which outline the technical approach for identification and delineation of HO-impacted groundwater as outlined in the AO. The contents of each chapter are described below.

Chapter 1.0, Introduction, presents the site history, purpose, scope, regulatory setting, previous investigations, and organization of the GWMP.

Chapter 2.0, Conceptual Models, provides a visualization and description of potential sources, media of interest, dioxin constituents of concern, nature of dioxin constituents, dioxin constituent transport and deposition, and the process for sample collection in a phased approach.

Chapter 3.0, Field Investigation, presents the phased delineation approach to identification and delineation of dioxin-impacted media.

Chapter 4.0, Analytical Program, outlines the guidelines for sample collection, sample analysis, data validation, and data management.

Chapter 5.0, Data Evaluation and Interpretation, provides the general outlines for the summary of Phase I activities. The recommendations of the summary report will be used to guide the Phase II activities.

Chapter 6.0, Project Sequence, provides a general sequence of actions from monitoring plan approval to contract award.

CHAPTER 2.0

2.0 SITE CONCEPTUAL MODELS

Chapter 2.0 provides a conceptual understanding of potential sources, media of interest, the dioxin constituents of concern, the physical and chemical nature of dioxin constituents, dioxin fate and transport, and the process for sample selection and collection in the phased approach.

The conceptual models developed in this chapter will be used to guide the investigative and remedial processes in the most efficient manner possible. These conceptual models provide the basis for initial sample selection and eventually will help in selecting the most effective remedial options. The conceptual models will be refined during the investigative process as new information is assimilated.

2.1 HYDROGEOLOGICAL SETTING. A complex relationship exists between surface water and groundwater in the vicinity of NCBC Gulfport. Depending on precipitation amounts and intervals, a stream or ditch system may be losing (surface water seeps into groundwater) or gaining (groundwater seeps into ditch). This relationship was observed at Site 6 during an investigation of two burn pits (ABB-ES, 1994b). The relationship is compounded because there is no evidence of a continuous confining layer that isolates the surface water and shallow groundwater from deeper aquifer units.

Surface water and groundwater interaction is important to this investigation because of the nature of potential contaminants that exist at the sites on this base. Of particular interest in this investigation is the dioxin remaining from the storage and handling of HO, but a wide range of solvents and fuels were also handled and disposed of on this base. These fuels and solvents tend to increase the mobility of dioxin.

Ultimately, the relationship between surface water, sediment, surface soil, and groundwater dictates the transportation and depositional patterns of the contaminants that exist onbase. Understanding this relationship allows for predictive assumptions that will guide the investigation, and eventually remediation, activities in a faster, more cost effective manner. A focused look at the surface water and groundwater hydrology relationships precede the presentation of the conceptual models.

Surficial Aquifer System. NCBC Gulfport is underlain by several thick, unconsolidated aquifer systems. These systems are Holocene (uppermost), underlain by the Pleistocene, and the Miocene aquifers. The (Holocene) alluvium at NCBC Gulfport is the primary unit of focus for this investigation since the primary contaminants of concern are not likely to migrate vertically into the Pliocene or Miocene aquifer units up to 100 feet below land surface (bls) (Shows, 1970).

At the surface, the Holocene alluvium deposits consist of discontinuous layers of sand, silt, clay, and minor gravel. Depth to groundwater is variable depending on precipitation, but generally ranges from 4 to 7 feet bls. The thickness of these alluvial deposits is up to approximately 80 feet.

Groundwater in the alluvial deposits at the NCBC is shallow (4 to 7 feet bls), typically has a low pH and has a general horizontal flow component to the west-northwest (Figure 2-1) (ABB-ES, 1995a). Localized flow directions may be influenced by proximity to surface water bodies. The vertical component of groundwater flow has been investigated at Site 6 (ABB-ES, 1994b). The results of that study indicated a downward component of flow, although the magnitude of the downward component has varied seasonally and with precipitation patterns.

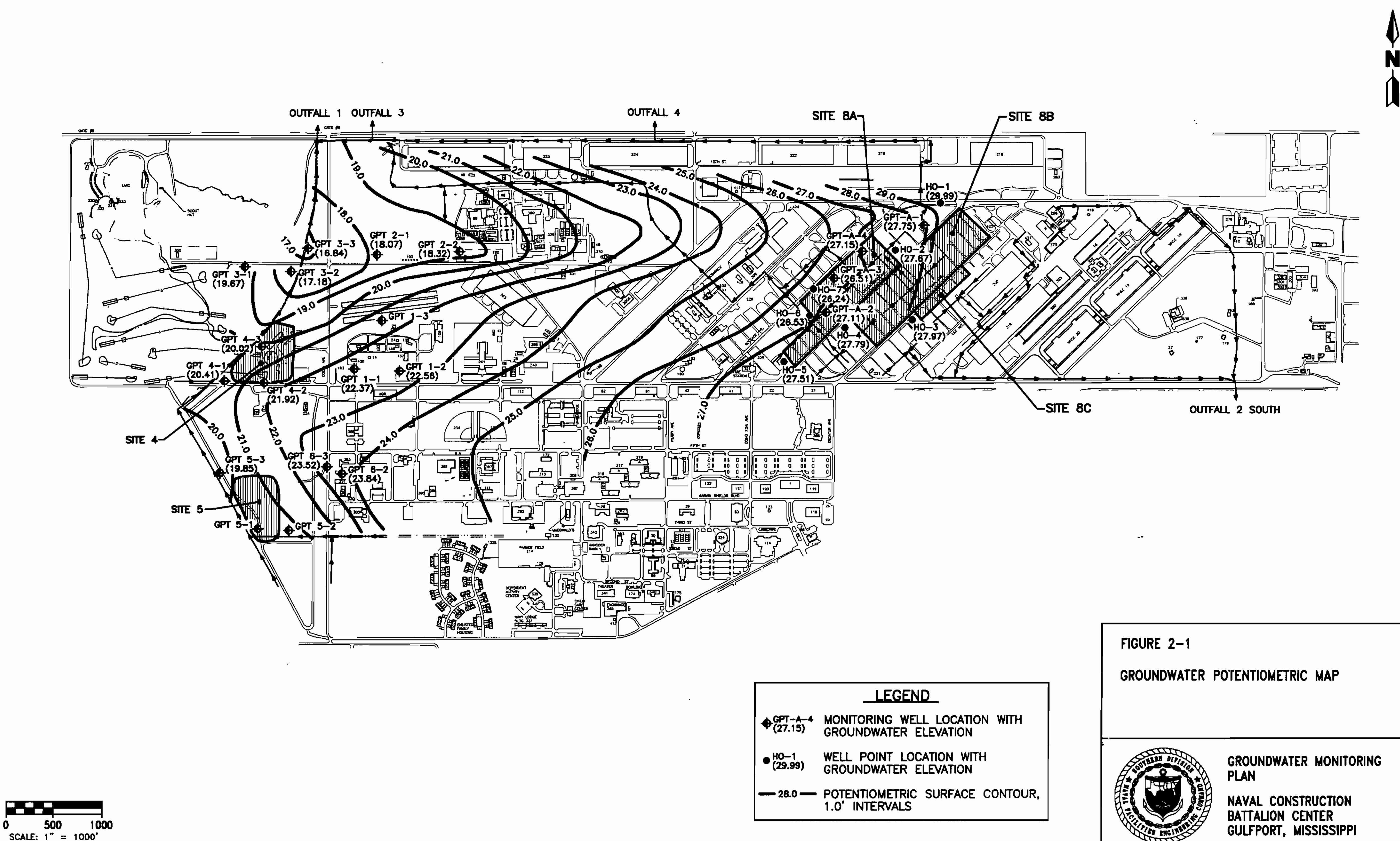
Below the Holocene alluvial deposits, Pleistocene terrace deposits consisting of thick lenticular sand and gravel layers separated by thinner clay layers, range for approximately another 100 feet. The Citronelle aquifer is part of this section and is used extensively for domestic water supplies around the base. Water levels vary depending on proximity to surface water bodies and amount of groundwater production from water supply wells (Shows, 1970).

The aquifers of greatest importance to the area lie below the Pleistocene terrace deposits. These Miocene units consist of thick beds of sand and gravel with minor clay layers. These units are generally lenticular and discontinuous over the area (Shows, 1970). The contacts of the Miocene units are often difficult to distinguish from one another, which is the reason they have been collectively referred to as the "Miocene" aquifers. These units include the Graham Ferry, Pascagoula, Hattiesburg, and Catahoula. These aquifers are the primary source for municipal and industrial water supplies, including NCBC Gulfport.

<u>Surface Water</u>. Surface water in the region of the NCBC is abundant. Average annual mean rainfall in the area is approximately 65 inches per year (Shows, 1970). Individual storms are often intense with large 24-hour totals. The 10-year, 24-hour rainfall is approximately 10 inches (U.S. Soil Conservation Service, 1986); this rate is one of the highest totals for the entire continental United States. These large storms tend to be accompanied by small stream and ditch flooding and flow velocities that scour out streambed loads of sediment. Previous investigations have shown that dioxin-contaminated sediment is mobile and leaving the base through the ditch systems that capture and transmit storm-water and surface water from the former HO storage area (ABB-ES, 1995g). Obviously, these storms both increase the volume and rate of migration of this dioxin-contaminated sediment relative to normal flow conditions.

In the area around the base, surface water generally flows to the north or northeast (away from the Gulf of Mexico) towards Bernard Bayou and the Back Bay of Biloxi. Figure 2-2 displays the major ditches and streams that enter and leave the base and their flow directions. As shown on Figure 2-2, the primary sites of concern (Sites 4, 5, and 8) are located directly adjacent to or are drained by ditches that leave the base. The major surface water bodies that drain the base are Canal No.1, Turkey Creek, and Bernard Bayou.

While potential surface water and sediment contamination is not the focus of this investigation (see Onsite and Offsite Delineation Workplans, ABB-ES, 1996b and 1996c), the interaction of surface water and groundwater in areas contiguous with, or bisected by, Sites 4, 5, and 8 is important. It is necessary to develop an understanding of the migration pathways of contamination so that future engineering controls can be designed to isolate potential groundwater contamination from surface water contamination.



LEGEND

GPT-A-4 (27.15)	MONITORING WELL LOCATION WITH GROUNDWATER ELEVATION
HO-1 (29.99)	WELL POINT LOCATION WITH GROUNDWATER ELEVATION
28.0	POTENTIOMETRIC SURFACE CONTOUR, 1.0' INTERVALS

FIGURE 2-1

GROUNDWATER POTENTIOMETRIC MAP

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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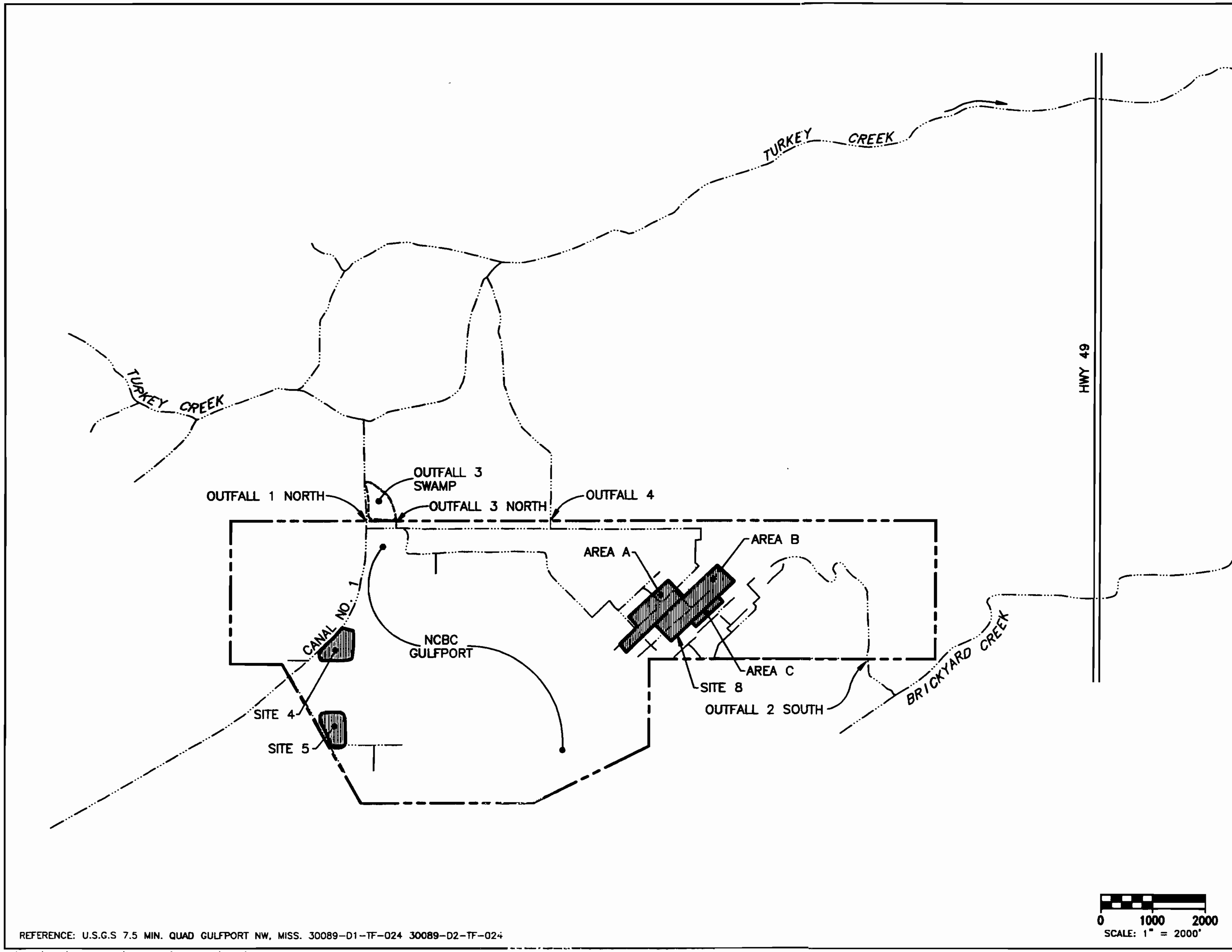

FIGURE 2-2

SURFACE WATER SYSTEM

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

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2.2 DISPOSAL PRACTICES AND TARGET AREAS. While the focus of this document is dioxin and HO constituents, the disposal practices of other chemicals and materials cannot be ignored. For instance, organic solvents disposed of in landfills could mobilize dioxin molecules otherwise bound to soil and or sediment particles. This creates the potential for a larger area of contamination than could be reasonably assumed if no solvents were present. As another example, the burning of oils containing polychlorinated biphenyl (PCBs) could produce certain congeners of the dioxin family that are wholly unrelated to the storage and handling of HO. Both of these practices took place at the base in the past and could have a direct impact on the execution of this work. It is the intention of this document to stay narrowly focused on HO and HO-related dioxin, while considering other chemicals only as they might impact the fate, transport, and extent of HO and dioxin.

2.2.1 Past Disposal Practices From 1942 until 1972, virtually all solid and most liquid wastes generated by the base were disposed of in onsite trench-and-fill facilities (Naval Energy and Environmental Support Activity [NEESA], 1985). The operation generally consisted of incinerating the solid and liquid wastes and pushing the ash and noncombustible material into the trenches. Disposal operations like this would occur within a several acre area for several years, then the operations would move to a new location.

From 1942 until 1972, four locations were used for these operations: Sites 1, 2, 3, and 4. Aside from the solid wastes, these sites received liquid wastes that included oils, fuels, paints, paint strippers, solvents, and cleaning compounds. Starting in 1972, much of the solid wastes generated by the base were disposed of at offbase facilities, although the practice of burning and disposing of liquid wastes onbase continued until 1976. Table 2-1 summarizes the past disposal practices at the base and the years of operation for each of the landfills and Installation Restoration (IR) sites. Of these nine IR sites, only three are currently considered as primary target areas. They are Site 4, Golf Course Landfill; Site 5, Heavy Equipment Training Area; and Site 8, Herbicide Orange Storage Area.

2.2.2 Target Areas This section outlines the areas onbase where the efforts of this GWMP will be focused. The target areas of this investigation will be Sites 4, 5, and 8. As shown in Table 2-1, Sites 1, 2, and 3 operated from 1942 until 1966, prior to the storage and handling of HO on the base. Groundwater at Site 6 has already been characterized for HO and dioxin (with no evidence of HO disposal), and Site 7 operated after the drums of HO were removed from the base.

According to the Initial Assessment Study (IAS) (NEESA, 1985), Site 4 was operated as a landfill from 1966-1972 as a trench-and-fill operation and was only operating landfill at the time. Solid and liquid wastes were disposed of sometimes burned at the site. Site 5 was operated as a landfill from 1972 to 1976 as a trench-and-fill operation and was the only operating landfill at the time. Solid and liquid wastes were disposed of and sometimes burned at Site 5, including reportedly 50 to 100 drums of liquid dichlorodiphenyltrichloroethane (DDT). There is no report in the IAS of HO disposal, but due to the operational dates, drums may have been placed in the landfill.

The efforts at Site 8 will be focused on delineating the limits of groundwater that has been known to contain dioxin (ABB-ES, 1996a).

Table 2-1
Disposal Areas

Groundwater Monitoring Workplan
Naval Construction Battalion Center
Gulfport, Mississippi

Site No.	Site Name	Period of Operation	Waste Types	Estimated Total Quantities	Sources
1	Disaster Recovery Disposal Area	1942 - 1948	Paints, oils, solvents, paint strippers, and cleaning compounds	Unknown	Public works shops, supply
2	World War II Landfill	1942 - 1948	General refuse, paints, oils, solvents, paint strippers, and cleaning compounds	Unknown	Dumpsters throughout NCBC
3	Northwest Landfill/ Burning Pit	1948 - 1966	Solid waste, oils, fuels, paints, paint strippers, solvents, and cleaning compounds	30,000 tons of solid waste, unknown quantities of other liquid wastes; 130,000 gallons of flammable liquids burned in pit	All NCBC industrial operations
4	Golf Course Landfill	1966 - 1972	Solid waste, oils, fuels, paints, paint strippers, solvents, and cleaning compounds	16,000 tons of solid waste; unknown quantities of other liquid wastes	All NCBC industrial operations
5	Heavy Equipment Training Area Landfill	1972 - 1976	Refuse and tree clippings, DDT, paints, oils, solvents, paint strippers, and cleaning compounds	6,000 cubic yards of solid waste; 50 to 100 drums of DDT	All NCBC industrial operations
6	Fire-Fighting Training Area	1966 - 1975	Waste fuels, oils, solvents, paint and paint strippers	500,000 gallons	CED, 20th NCR, NCTC, public works shops
7	Rubble Disposal Area	1978 - 1984	Concrete, lumber, scrap metal, and similar inert materials	Unknown	Construction and building demolition debris
8	Air Force Herbicide Orange Spill Area	1968 - 1977	Herbicide orange	Spillage from storage of 15,400 55-gallon drums at site	Air Force
9	Building Foundation 271 Excavated Drum Storage Area	1984	Toluene, xylene, and 1,2-dichloroethane	Four or five 55-gallon drums	Excavated from Site 1

Notes: Shading denotes target areas.

NCBC = Naval Construction Battalion Center.
DDT = dichlorodiphenyltrichloroethane.
CED = Construction Equipment Department.
NCR = Naval Construction Regiment.
NCTC = Naval Construction Training Center.

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2.2.3 Target Analytes The target analytes during this investigation, as outlined in the AO, are the dioxin and furan congeners; the constituents that make up HO (2,4-dichlorophenoxyacetic acid [2,4-D] and 2,4,5-trichlorophenoxyacetic acid [2,4,5-T]); and other chemicals (volatiles, semivolatiles, etc.) that may affect dioxin fate and transport in the subsurface. The phenoxy-herbicides 2,4-D and 2,4,5-T are combined to create HO in which the dioxin congeners form as a trace impurity. Groundwater and soil samples will be analyzed for high resolution dioxin and furan analysis as well as the phenoxy-herbicides.

Total organic carbon (TOC) in the soil samples will be analyzed. TOC has proven to be an indicator for likely areas of dioxin in stream sediments (ABB-ES, 1995h). The effectiveness of TOC as a dioxin indicator will be used to guide sampling efforts. TOC results also could prove especially useful during any remedial activities that require removal of impacted sediment or surface soil. Volatile organics and pesticides will also be analyzed in soil samples from Sites 4 and 5.

Groundwater samples will be analyzed for the full suite of Appendix IX analytes (U.S. Environmental Protection Agency [USEPA], 1994a) in addition to dioxins and furans. The analytical program is more fully discussed in Chapter 4.0.

2.2 MEDIA OF INTEREST.

The environmental media of interest in this plan is groundwater and associated subsurface soil. This investigation will focus on these media and the mechanisms that may have resulted in the release of HO and dioxin to the environment.

2.3 CHEMICAL AND PHYSICAL NATURE OF HO AND DIOXIN.

The following discussion provides some of the basic terminology and conventions associated with toxicity equivalents for dioxin. The compound 2,3,7,8-TCDD is created as an incidental contaminant in the manufacturing process for HO. The process to manufacture HO involves combining a mixture of 2,4-D and 2,4,5-T in which 2,3,7,8-TCDD may be created at levels up to 2 parts per million (ppm). 2,3,7,8-TCDD is considered to be the most toxic of the polychlorinated bibenzodioxin and dibenzofuran families. Individual polychlorinated dibenzodioxins and polychlorinated dibenzofurans, called congeners, with chlorine atoms at the 2, 3, 7, and 8 molecular positions (2,3,7,8 substituted compounds) can mimic the toxic properties of 2,3,7,8-TCDD. The USEPA (1989) developed toxicity equivalency factors (TEFs) for each of the congeners with 2,3,7,8-substituted chlorine atoms to quantify the toxicity of these congeners relative to 2,3,7,8-TCDD, which is assigned a TEF of one.

To determine the TEQ of a particular sample result, the laboratory result of each congener is multiplied by the assigned TEF to determine a 2,3,7,8-TCDD equivalent concentration. The equivalent total concentrations are then summed to obtain the toxicity equivalent or TEQ. Those congeners without substitutions at the 2,3,7,8 molecular positions were not considered toxic, at least in terms of carcinogenic potency, and were assigned a TEF of zero.

For example, 2,3,7,8-pentachloro-p-dioxin (2,3,7,8-PeCDD) has a TEF of 0.5. If the sample result reported 100 picograms per liter of 2,3,7,8-PeCDD, the TEQ for this congener would be 50 picograms per liter ($100 \times 0.5 = 50$).

Dioxin is a colorless and odorless solid at room temperature, has a very low aqueous solubility (octanol-water partition coefficient equals 1.93×10^{-5}), and is not likely to be dissolved in water at concentrations above 20 ppt (Arienti and others, 1988). However, dioxin is soluble in oils, fats, and organic solvents. For instance, dioxin solubility in organic solvents such as benzene, xylene, and toluene ranges from 500 to 1,800 ppm. Dioxin has a specific gravity greater than water and a strong affinity for organic carbon.

Dioxin is known to have a long half life (low rate of biodegradation) in nature before breaking down. Some recent studies have found degradation rates for dioxin in soil at nearly zero for a 12-year test period (Arienti and others, 1988). In practice, ultraviolet light has little impact on the molecular structure of dioxin in nature. Thermal decomposition of the dioxin molecule does not begin until temperatures reach between 1,200 and 1,400 degrees Celsius (Arienti and others, 1988). The components of HO (2,4-D and 2,4,5-T) have much shorter half lives in nature than dioxin does and are readily broken down by ultraviolet light.

HO was mixed with diesel fuel and was stored as a mixture at Site 8 (Arienti et al, 1988). This diesel fuel mixture has potentially made the dioxin particles more mobile in the soil and groundwater. In fact, if HO was disposed of in either of the landfills at Sites 4 or 5, solvents such as those known to have been disposed of may increase the mobility of HO and dioxin in soil and groundwater.

__2.4 FATE AND TRANSPORT OF DIOXIN__. As stated earlier, the fate of dioxin in nature is generally that the stable dioxin molecule remains unchained and normally attached to soil particles (ABB-ES, 1994a). The lack of naturally occurring processes that attack or break the molecular bonds in dioxin results in a chemical that may be hindered or even completely bound up in a soil or sediment matrix, but not one that can be reasonably expected to degrade significantly over time (Arienti et. al., 1988).

The transportation of dioxin at the base has been observed through sediment and surface water following the erosion of soil containing dioxin at Site 8. The dioxin molecules are primarily attached to fine-grained soil particles or organic matter (ABB-ES, 1995a).

Another potential transportation mechanism, but one that has not yet been quantified, is the movement of dioxin through groundwater. The confirmed presence of dioxin at Sites 4 and 8 along with the presence of known solvents makes groundwater transportation of dioxin possible. While no groundwater samples from Site 5 have been found to contain dioxin, the potential still exists because there are no monitoring wells downgradient from any of the Site 5 disposal cells.

At Site 8, there are no apparent biological receptors for potential dioxin-contaminated groundwater. But Sites 4 and 5 both have large ditches running along the downgradient sides of both landfills. If dioxin has been mobilized in either of those sites by the organic solvents, then seeps that are present along the ditches of both landfills could potentially be transporting dioxin directly into the surface water and sediment of these ditches.

2.5 CONCEPTUAL MODELS. Two components of a conceptual model are provided in this section; a three-dimensional schematic keyed to a narrative description for the three target areas represent the sum of information currently known or understood about the sites.

Site 8 – Former HO Storage Area. Figure 2-3 is a schematic view provided to support the conceptual model for Site 8. The numbered text items that appear on that figure are expanded upon in this accompanying site conceptual model text page.

1. HO was stored in 55-gallon drums on Areas A, B, and C from 1968 to 1977. The drums were stacked on their sides, and spills were a common occurrence. The herbicide in the drums was mixed with diesel fuel (Arienti et al, 1988), which aided application. Dioxin, particularly TCDD, occurs as a contaminant when 2,4,5-T (one of the components of HO) is manufactured.

2. When spills occurred, HO would seep into the sandy soil. No attempts were made to contain or remove spilled material. Since diesel fuel is a solvent for dioxin, dioxin molecules migrated down through the unsaturated soil zone. However, the levels of dioxin contamination in the surface soil were investigated prior to the excavation and incineration and were shown to decrease with increasing depth. The highest levels of dioxin contamination at Site 8 was 1,000 ppb. That sample was collected from the stabilized surface soil layer during the early delineation activities in 1986 (EG&G, 1988).

3. Although dioxin levels have been shown to decrease with depth, dioxin-contaminated groundwater was discovered at Site 8. The highest detected dioxin TEQ sample result was 60 ppq (ABB-ES, 1995c). During that investigation, dioxin levels were observed to decrease when water levels were lower and increase when water levels rose, which confirms that dioxin levels decrease with depth, even in groundwater.

4. Erosion and transportation of dioxin-contaminated soil and sediment has been observed through Outfalls 1, 3, and 4 north. The highest dioxin sample results have been obtained from organic rich sediment in the lower energy environments in the ditch system that flows off of Site 8. The highest dioxin TEQ from sediment is 150 ppt at Outfall 3.

5. Dioxin-contaminated soils at Site 8 above 1 ppb were remove and incinerated in 1987 and 1988. The resulting ash was piled on Site 8, Area A. Confirmation sampling indicated that the cleanup goal of 1 ppb was reached. The regulatory standards for dioxin-contaminated soil were made more stringent in 1989.

6. Four monitoring wells were installed around Site 8, Area A in 1994. All of the wells produced samples that contained dioxin. Even though the highest levels were consistently observed in a single well (GPT-4-2), the entire Area A has to be considered to potentially contain dioxin-contaminated groundwater until approximate limits of contamination are defined.

7. Groundwater samples have not yet been collected from Areas B and C. Surface soil contamination in these areas was lower than at Area A, which

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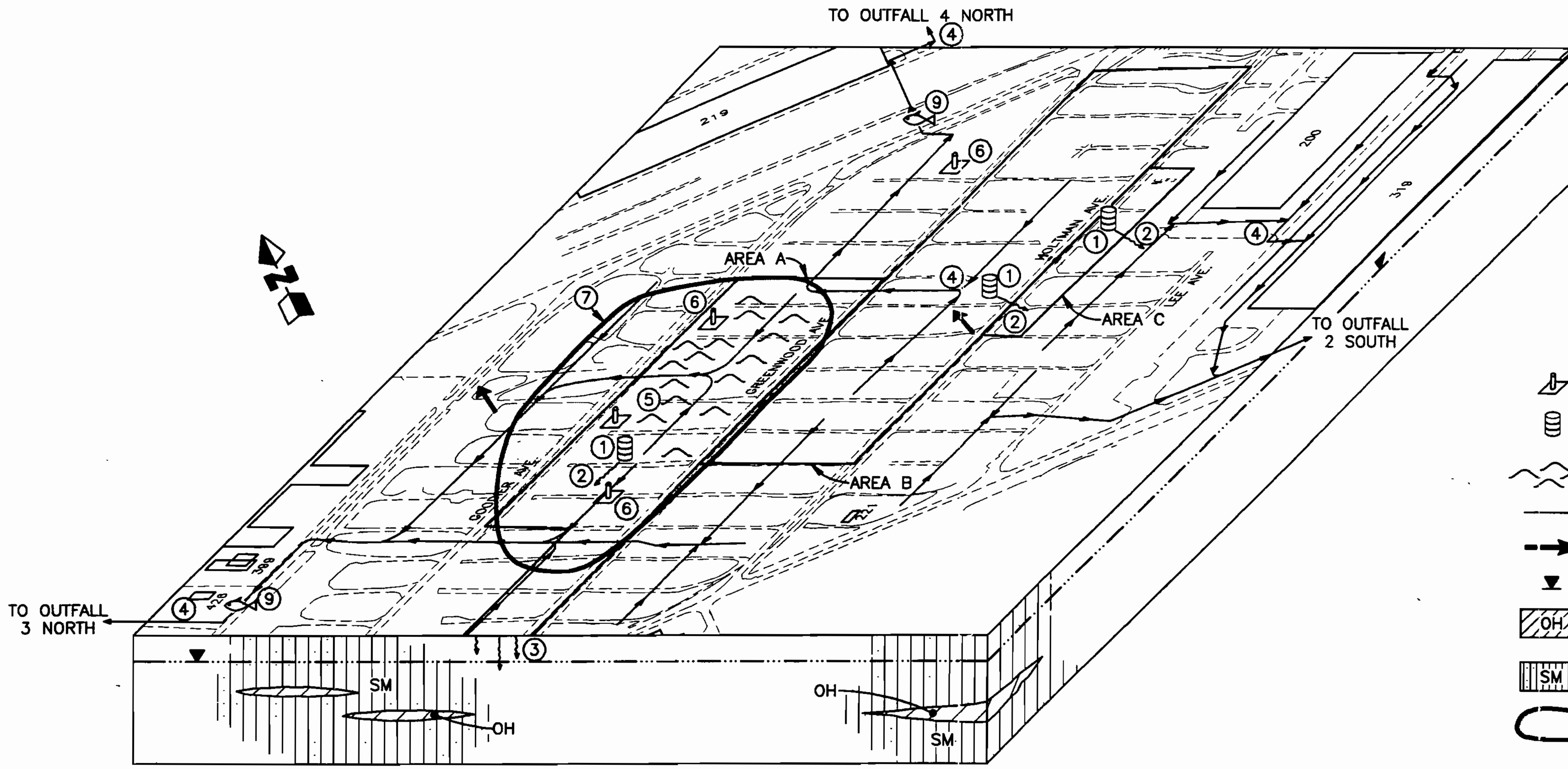

EXPLANATION

- EXISTING MONITORING WELLS
- HERBICIDE ORANGE DRUMS (STORED FROM 1968 TO 1977)
- ASH PILES
- SURFACE WATER FLOW DIRECTIONS
- GROUNDWATER FLOW DIRECTION
- GROUNDWATER LEVEL
- OH DISCONTINUOUS ORGANIC SILTY CLAYS
- SM FINE AND MEDIUM SAND WITH SOME SILT
- AREA OF KNOWN GROUNDWATER CONTAMINATION
- BIOTA
- (9) TEXT CUE

SOURCES AND POTENTIAL RELEASE

* DRUMS OF HERBICIDE ORANGE (1968–1977) (PRIMARY SOURCE)
* DIOXIN CONTAINING SOIL, SEDIMENT, AND GROUNDWATER (SECONDARY SOURCE)
* ASH PILES CONTAINING LOW LEVELS OF DIOXIN (TERTIARY SOURCE)

CONTAMINANT MIGRATION PATHWAYS

* EROSION AND MIGRATION OF DIOXIN CONTAINING SURFACE SOILS
* MIGRATION OF DIOXIN–CONTAINING SEDIMENT THROUGH DITCH SYSTEM
* HERBICIDE ORANGE AND DIOXIN–SEEPING THROUGH SOIL INTO GROUNDWATER
* MIGRATION OF DIOXIN THROUGH GROUNDWATER
* WIND–BLOWN SOIL PARTICLES CONTAINING DIOXIN
* MECHANICAL REMOVAL OF DIOXIN CONTAINING SEDIMENT, SOIL, AND ASH

RECEPTORS (PHYSICAL AND BIOLOGICAL)

* SOIL, ESPECIALLY ORGANIC RICH
* SEDIMENT, ESPECIALLY IF ORGANIC RICH
* BIOTA LIVING OR FEEDING AT SITE 8 OR IN AFFECTED DITCH SYSTEMS

FIGURE 2–3

CONCEPTUAL MODEL
SITE 8

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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may indicate lower groundwater dioxin results. But in practice, a number of other factors such as soil type and soil cement thickness could impact vertical migration of dioxin to a greater extent than concentration gradients.

8. Air sampling conducted in conjunction with sediment removal activities along 28th Street in 1995 (ABB-ES, 1996e) indicated the presence of wind-blown levels of dioxin. The levels were in the low ppq range.

__Site 4 – Golf Course Landfill__. Figure 2-4 is schematic view provided to support the conceptual model for Site 4. The numbered text items that appear on that figure are expanded upon in this accompanying Site Conceptual Model Text Page.

1. Figure 2-4 shows the locations and orientations of the magnetic anomalies resulting from a geophysical survey conducted in 1995. An EM-31™ was used to identify shallow buried metals and conductive soils. The EM-34 was used to identify conductive zones below 20 feet, and an EM-61 was used to identify buried metal debris. The outlines shown on this figure are a combination of all of the identification techniques and should roughly depict the original disposal areas that contained metal debris (including 55-gallon drums). Obviously, many of these anomalies, which may correspond to buried cells, lie directly under the golf course.

2. Virtually all liquid and solid wastes generated onbase from 1966 to 1972 were disposed of in the landfill. This time period coincides with the storage of HO onbase and Hurricane Camille. There have been reports that drums damaged in Hurricane Camille were disposed of in this landfill.

3. Liquid wastes known to be disposed of in this landfill include fuels, oils, solvents (methyl ethyl ketone [MEK], toluene, and xylene), paints, and paint thinners. Many of these liquids, especially the solvents, will mobilize dioxin in the groundwater.

4. Three monitoring wells were installed during the IAS study. Unfortunately, the two wells intended for downgradient locations are actually in cross-gradient positions.

5. Well GPT-4-3 is located within the boundary of the landfill. Groundwater samples from this monitoring well resulted in detections of pesticides, PCBs, herbicides, and dioxin (34 ppq TEQ) (ABB-ES, 1995a).

6. Groundwater flow direction at this site is west and northwest towards Canal No. 1. There are no monitoring wells downgradient of the major disposal cells.

7. Seeps from the east bank (landfill side) of Canal No.1 are evident during most of the year. These seeps can be of varying colors and they produce a noticeable sheen on the water where they empty into Canal No. 1. Neither the seeps or surface water in the vicinity has been sampled.

8. Groundwater depths are up to 10 feet bls at this site. The increased depth to water is the result of landfill and cover material.

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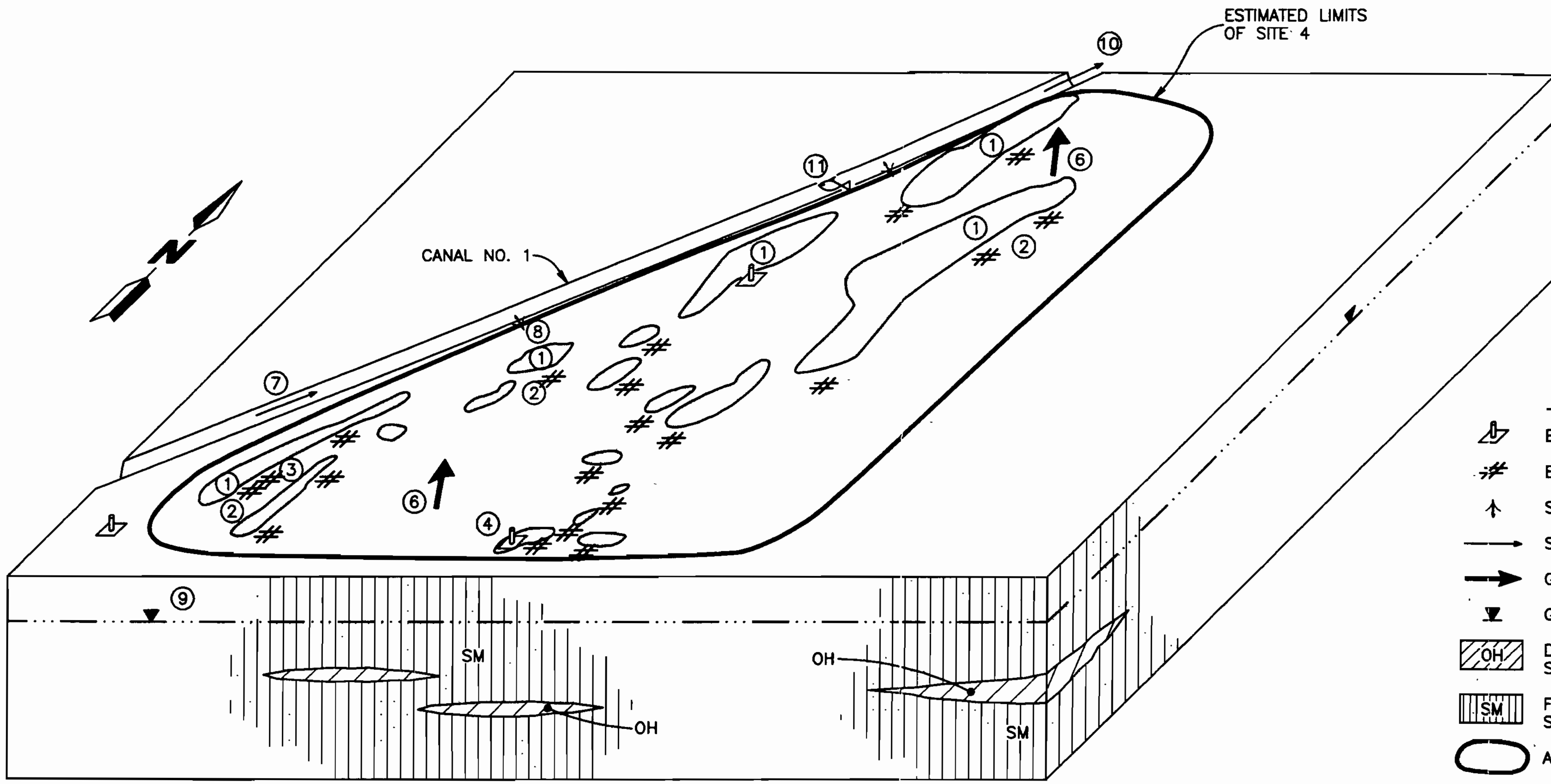

EXPLANATION

- EXISTING MONITORING WELLS
- BURIED METAL DEBRIS
- SEEPS FROM BANK OF CANAL NO. 1
- SURFACE WATER FLOW DIRECTIONS
- GROUNDWATER FLOW DIRECTION
- GROUNDWATER LEVEL
- OH DISCONTINUOUS ORGANIC SILTY CLAYS
- SM FINE AND MEDIUM SAND WITH SOME SILT
- APPROXIMATE EXTENT OF DISPOSAL CELLS
- BIOTA
- 9 TEXT CUE

SOURCES AND POTENTIAL RELEASE

* SOLID WASTE FROM BASE DUMPSTERS
* LIQUID WASTES GENERATED ON BASE
  – FUELS, OILS, SOLVENTS (MEK, TOLUENE, XYLENE), PAINTS, AND PAINT THINNERS
* DRUMMED LIQUID WASTES
  – ABOVE LISTED LIQUIDS
  – POTENTIALLY, DAMAGED HERBICIDE ORANGE DRUMS
* HURRICANE CAMILLE DEBRIS

CONTAMINANT MIGRATION PATHWAYS

* POTENTIALLY CONTAMINATED GROUNDWATER FLOWING TO THE WEST–NORTHWEST
* SEEPS AT THE EDGE OF THE LANDFILL CARRYING POTENTIALLY CONTAMINATED FLUIDS INTO CANAL NO. 1
* SURFACE WATER AND SEDIMENT IN CANAL NO. 1 FLOWING NORTH, EXITING THE BASE AT OUTFALL 1 NORTH

RECEPTORS (PHYSICAL AND BIOLOGICAL)

* SOIL AND GROUNDWATER AT SITE 4
* SURFACE WATER AND SEDIMENT IN CANAL NO. 1
* SOIL THAT RECEIVES OVERFLOW FROM CANAL NO. 1
* ORGANISMS THAT LIVE OR FEED IN CANAL NO. 1

FIGURE 2–4

CONCEPTUAL MODEL
SITE 4

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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Site 5 – Heavy Equipment Training Area Landfill. Figure 2-5 is the conceptual model for Site 5. The numbered text items that appear on that figure are expanded upon in this accompanying Site Conceptual Model Text Page.

1. Figure 2-5 shows the locations and orientations of the magnetic anomalies resulting from a geophysical survey conducted in 1995. An EM-31 was used to identify buried metals and conductive soils. The EM-34 was used to identify conductive zones below 20 feet, and an EM-61 was used to identify buried metal debris. The outlines shown on this figure are a combination of all of the techniques and should roughly depict the original disposal areas that contained metal debris (including 55-gallon drums). While the shapes and sizes of the individual cells and magnetic anomalies vary, either analytical data or direct observation (trenching) is required to accurately determine which cell(s) contain the 55-gallon drums of DDT.

2. Reports indicate that drums of DDT and other liquid wastes were disposed of in this landfill. The operation of this landfill coincided with the storage of HO at Site 8.

3. The solid wastes disposed of in this landfill include some of the solid dumpster waste and 12 pounds of powder DDT. Liquid wastes included 50 to 100 55-gallon drums of liquid DDT, fuels, oils, solvents (MEK, toluene, and xylene), paints, and paint thinners.

4. Three existing monitoring wells were installed around Site 5, although only one is downgradient of the disposal cells within the landfill.

5. After these existing wells were installed, it was discovered that groundwater in the surficial aquifer flows to the west-southwest in this location. The initial wells were placed with the assumption that groundwater flowed to the south.

6. Drainage ditches run along the side the landfill on the south and west. The flow directions are to the west and north, where the ditch eventually drains into Canal No. 1. A sediment sample collected in the ditch that drains off Site 5 contained TCDD and had a TEQ of 74. While this result does not confirm disposal of HO in Site 5, it does indicate that this potential source and contaminant migration pathway needs to be addressed.

7. Seeps have been observed emanating from the north (landfill) side of the drainage ditch that runs along the south side of Site 5. These seeps have a visible sheen, although, to date, no samples have been collected for analysis.

8. Like Site 4, the groundwater is a little deeper than the surrounding area due to several feet of landfill cover. Reportedly, the cover material is a fine to medium sand with little silt. Therefore, the cover does not prevent infiltration or seepage into the landfill.

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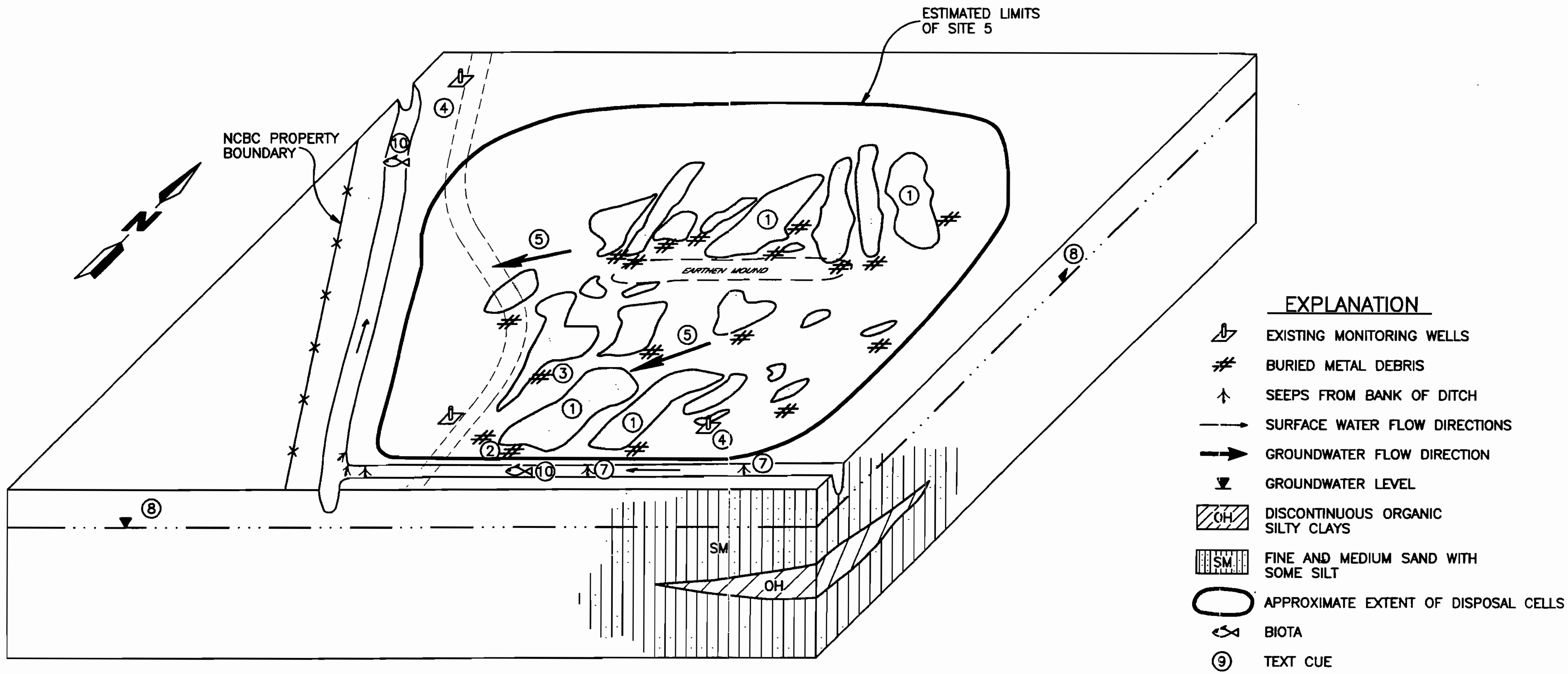

SOURCES AND POTENTIAL RELEASE

* SOME BASE SOLID WASTE, 12 LBS. OF POWDERED DDT
* LIQUID WASTES (DRUMMED AND UNDRUMMED)
  - FUELS, OILS, SOLVENTS (MEK, TOLUENE, XYLENE), PAINTS, AND PAINT THINNERS
  - 50 TO 100 55-GALLON DRUMS OF DDT
  - REPORTEDLY 55-GALLON DRUMS OF HERBICIDE ORANGE

CONTAMINANT MIGRATION PATHWAYS

* POTENTIALLY CONTAMINATED GROUNDWATER FLOWING TO THE WEST-SOUTHWEST
* SEEPS AT THE EDGE OF THE LANDFILL FLOWING INTO CANAL NO. 1
* SURFACE WATER AND SEDIMENT IN DITCHES FLOWING NORTH INTO CANAL NO. 1

RECEPTORS (PHYSICAL AND BIOLOGICAL)

* SOIL AND GROUNDWATER AT SITE 5
* SURFACE WATER AND SEDIMENT IN DITCHES LEADING AWAY FROM SITE
* ORGANISMS THAT LIVE OR FEED IN THE DITCHES

FIGURE 2-5

CONCEPTUAL MODEL
SITE 5

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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CHAPTER 3.0

3.0 FIELD INVESTIGATION

The goal of the field investigation is to determine the extent of groundwater contamination associated with the storage and handling of HO on the base and to provide a definitive basewide potentiometric surface. The investigation will encompass a focused, two-phased approach to meet the goals of this project while striving to control costs by limiting the number of samples and permanent monitoring wells.

The investigation will be divided into two phases. The first will include using direct-push technology (DPT) to delineate dioxin-contaminated groundwater at Sites 4, 5, and 8, as well as determining the best locations for downgradient wells at Sites 1, 2, 3, and 7. The second phase includes the installation and sampling of permanent monitoring wells and the installation of piezometers to determine the basewide potentiometric surface.

3.1 PRELIMINARY ACTIVITIES. Prior to initiation of field activities, various mobilization tasks must be completed to ensure efficient field sampling events. The project team will develop specifications to initiate procurement of subcontractors and vendors for specialized services and equipment. Standard items for mobilization will be handled in accordance with Federal Acquisitions Regulations, with individual items being coordinated through the field operations leader and the task order manager.

Efforts also will be expended to ensure that coordination exists among the contractor, the base environmental coordinator, and a representative from Public Works while activities are occurring on the base. The contractor will keep the environmental coordinator informed of the scheduled field activities to prevent interference with base activities.

In general, the work described in this plan will be coordinated with ongoing environmental activities outlined in the Site Management Plan (ABB-ES, 1996f). The optimum sequence field activities, which will reduce mobilization and labor costs, will be developed in the site management plan.

3.2 FIELD INVESTIGATION. This section describes the approach of this GWMP to satisfy the requirements of the AO. First, the former landfills have been grouped according to the investigation objectives determined for each site. Sites 4, 5, and 8 may require delineation or characterization of groundwater within the site boundaries, while Sites 1, 2, 3, and 7 only require the installation and sampling of downgradient monitoring wells. The investigation for both groups will take place in two phases in order to best locate and reduce the number of permanent monitoring wells.

3.2.1 Sites 4, 5 and 8 Sites 4, 5, and 8 have either confirmed or suspected dioxin presence in the groundwater. This information is based on previous groundwater sample results, written documentation such as memos and manifests, and verbal communication from site personnel. The conceptual models (Chapter 2.0) for these sites unites this information with other site-specific data, such as the geology, hydrogeology, and geophysical investigation, which provides the basis for this two-phased approach. The process is graphically displayed in the Project Logic Diagram for Sites 4, 5, and 8 (Figure 3-1).

3.2.1.1 **Phase I Sites 4, 5, and 8** Based on the conceptual models for these sites, the first phase of the investigation will focus on characterizing and delineating, if necessary, dioxin in the groundwater. Characterization and delineation will be performed using DPT, such as the CPT in Phase I of the investigation. The groundwater samples will be collected through the rods of the direct-push equipment. The DPT is selected because it substantially reduces investigative-derived waste (IDW) while meeting the technical objectives. Other ongoing investigations may provide information that will allow a reduction in direct-push groundwater samples or permanent monitoring wells. Data from the Morrison Knudson (MK) (1996) investigation and the ABB-ES Onsite Delineation Workplan (ABB-ES, 1996b) will be evaluated to reduce the sampling and permanent monitoring well requirements in the execution of this workplan.

The first set of sample locations are primarily based on the geophysical study conducted by MK and their subcontractor (1996). The results of this study indicated the presence of magnetic anomalies that roughly indicate the locations of the discrete disposal cells in each of the landfills (Figures 3-2, 3-3, and 3-4). The initial direct-push samples at these sites are concentrated in and around these disposal cells because dioxin is not very mobile in groundwater (ABB-ES, 1995f). Figures 3-2, 3-3, and 3-4 also show the locations of the initial CPT samples for Sites 4, 5 and 8, respectively. A second set of samples may be collected with the CPT in and around the disposal cells that contain dioxin. The second CPT sampling round will include sufficient samples to characterize and delineate the areas that have dioxin-contaminated groundwater above the action level.

The CPT groundwater samples will be collected from a depth that is approximately the bottom of the disposal cell being investigated or 3 feet bls, whichever is deeper. Groundwater samples collected at this depth will identify the potential dioxin source regardless of whether it is located near the top of or the bottom of the disposal cell. The sample collection procedures are contained in Subsection 3.3.1, Technical Specifications for the CPT Investigation.

Site 4. The CPT investigation at Site 4 will begin around the disposal cells outlined on Figure 3-2. While the size and orientation of these cells have a great deal of variety, none of the cells could be excluded on that basis. The disposal practices outlined in Section 2.2, Disposal Practices and Target Areas, indicated that damaged drums of HO were disposed of in the landfill.

The initial sample results will be interpreted following receipt of validated data, and additional delineation samples will only be collected, if necessary, to delineate the extent of dioxin-contaminated groundwater. Once the delineation is complete, the site will move into Phase II, monitoring well installation.

Site 5. The CPT investigation at Site 5 will begin around the disposal cells outlined on Figure 3-3. While the size and orientation of these cells have a great deal of variety, none of the cells could be excluded on that basis. The disposal practices outlined in Section 2.2, Disposal Practices and Target Areas, indicated that nearly anything onbase could have been disposed of in the landfill

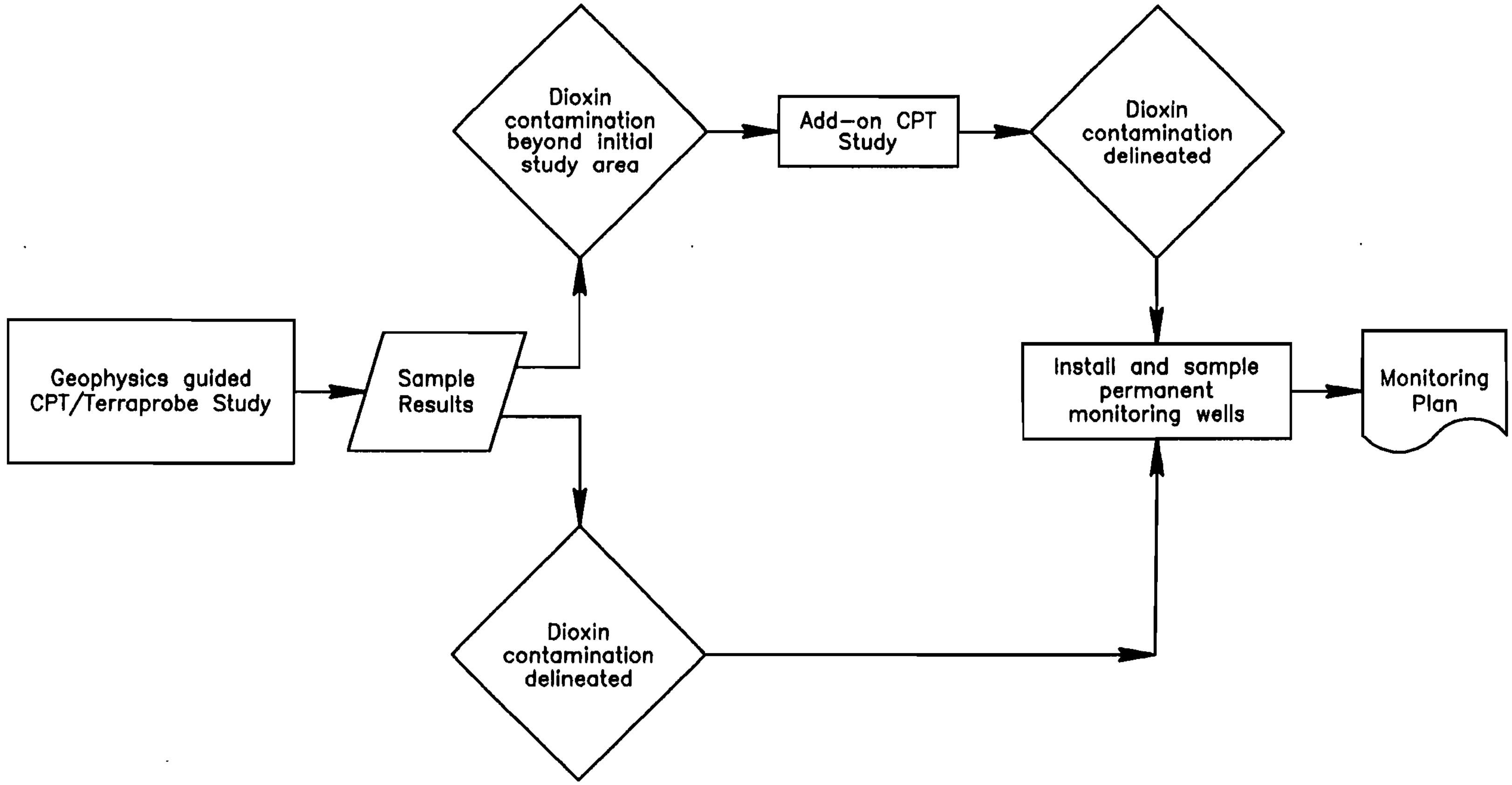

FIGURE 3-1

PROJECT LOGIC DIAGRAM
SITES 4, 5, AND 8

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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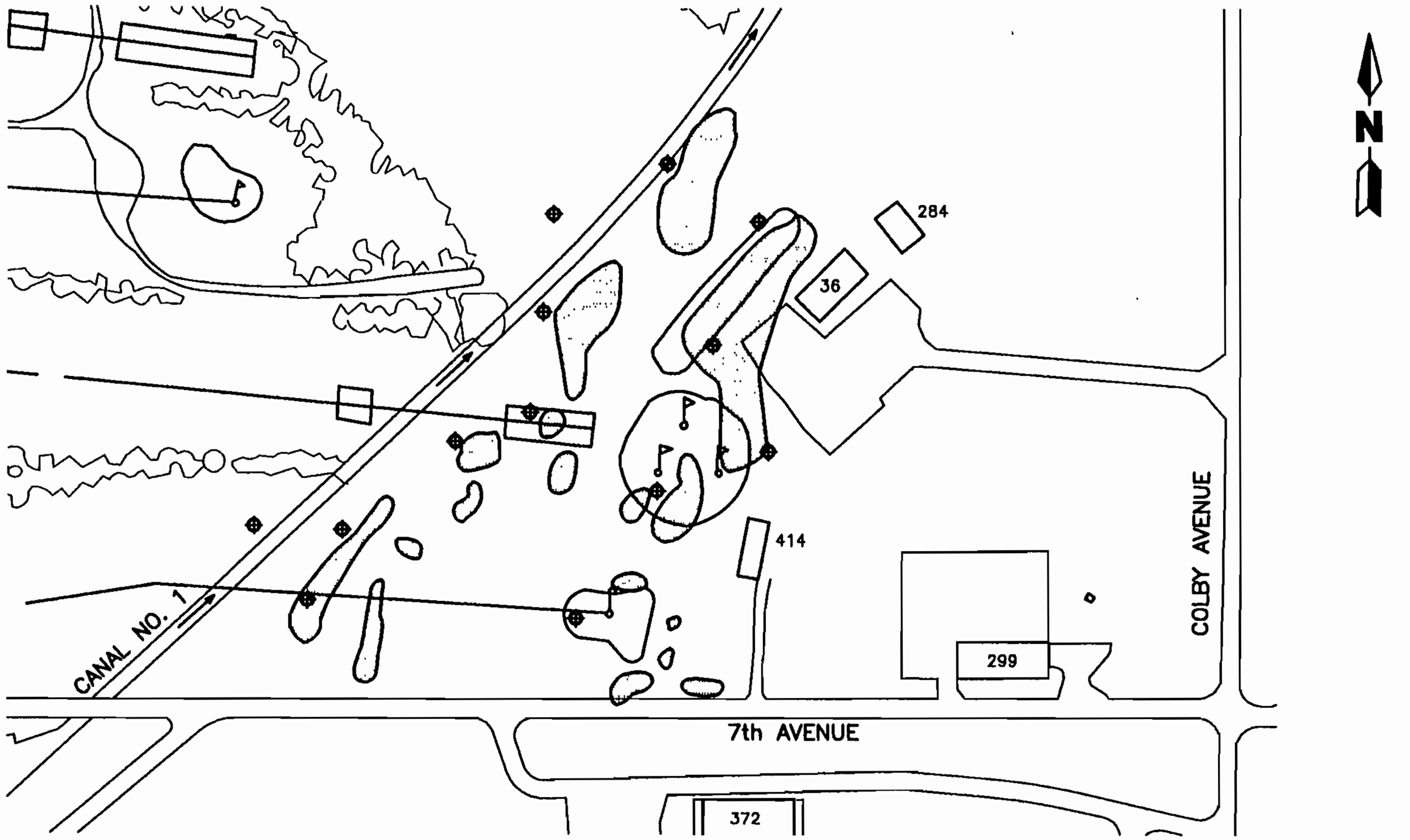

LEGEND

⊕ PROPOSED GROUNDWATER SAMPLE LOCATION

MAGNETIC ANOMALY

0 100 200
SCALE: 1" = 200'

FIGURE 3-2

PHASE I SAMPLE LOCATIONS:
SITE 4

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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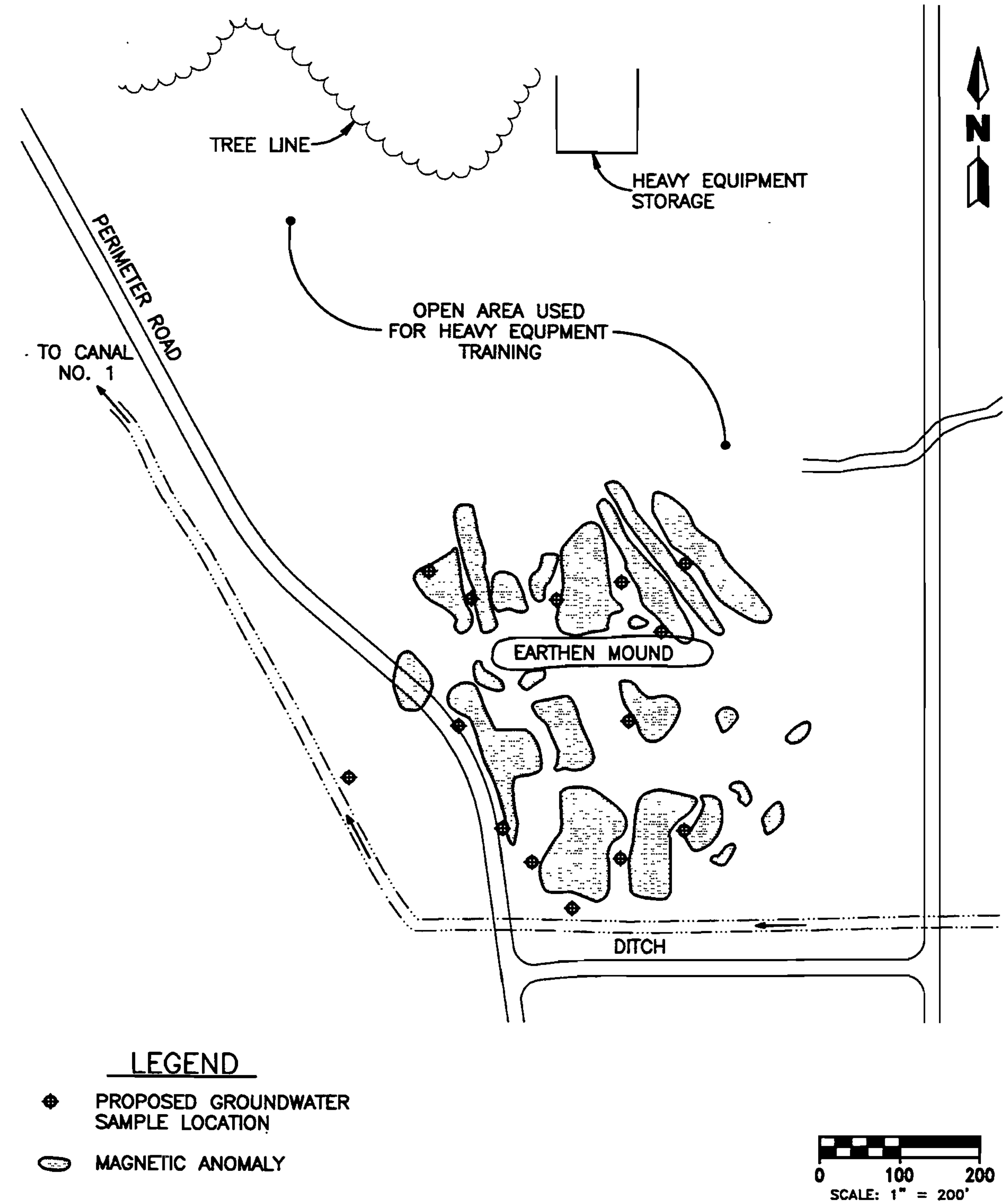

FIGURE 3-3

PHASE I SAMPLE LOCATIONS:
SITE 5

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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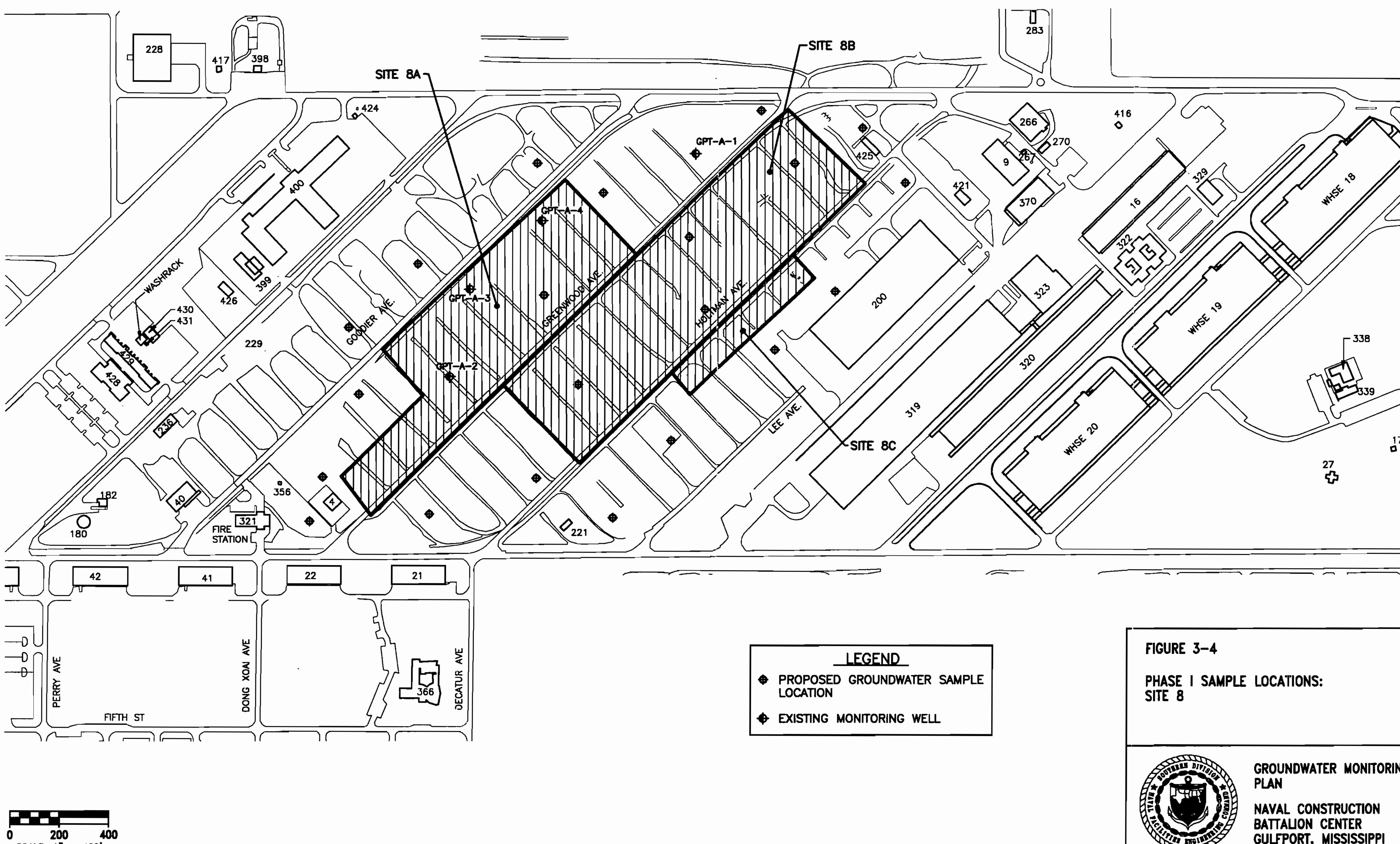

LEGEND

- PROPOSED GROUNDWATER SAMPLE LOCATION
- EXISTING MONITORING WELL

FIGURE 3-4

PHASE I SAMPLE LOCATIONS:
SITE 8

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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during its operation. Sediment samples near Site 5 have indicated the presence of dioxins, which may or may not be related to the disposal practices in the landfill.

<u>Site 8</u>. The CPT investigation will be performed differently at this site because the mechanisms for groundwater contamination is well understood and quite different from either Sites 4 or 5. Additionally, the groundwater is known to contain low levels of dioxin (ABB-ES, 1995b through 1995e). Based on the information gathered from the existing four wells and the history of the site, the objective of CPT sampling will be to determine the outer extent of dioxin-contaminated groundwater, as well as collection of a limited number of characterization samples within the site boundaries. A total delineation of dioxin-contaminated groundwater within the site boundaries is not proposed here.

The locations of Phase I samples are shown on Figure 3-4. These samples will be collected from a zone approximately 2 feet below the groundwater level. Selection of the zone was based on observations of depth versus dioxin levels. For example, during an observation of two monitoring wells in 1995 (ABB-ES, 1995, 1995e), it was discovered that when water levels dropped rapidly by more than 2.5 feet, dioxin levels dropped to nearly nondetect. This indicates that dioxin contamination generally tends to remain within 2 feet of the groundwater level.

These Phase I initial samples are shown on Figure 3-4. Additional samples will be collected if initial samples do not adequately delimit the extent of dioxin-contaminated groundwater. No additional characterization samples are proposed following the initial collection.

Preceding CPT sample collection at Sites 4 and 5, reference points will be surveyed in to allow accurate identification of the anomalies, which may approximate the locations of the disposal cells. The CPT sample locations will then be marked and staked.

Groundwater sample collection for high resolution dioxins and furans will be performed through the hydrocone, without the permanent installation of a monitoring well. Additional analytes will also be collected, including chlorinated herbicides (the components that were used to make HO), pesticides (reportedly disposed of in these landfills), and volatile and semivolatile compounds, because they may act as a carrier (solvent) for dioxins and furans. Organic carbon will be collected and analyzed from soil samples collected during monitoring well installation. Dioxins and furans have a strong affinity for this naturally occurring component of sediment, which may actually halt the migration of dioxins and furans.

3.2.1.2 **Phase II Sites 4, 5, and 8** The results of the CPT study will be used to identify the best locations for and the number of permanent monitoring wells to be installed in Phase II. The estimated number and type of wells to be installed as part of this workplan are shown in Table 3-1.

Monitoring wells will be installed to perform one of three objectives. First, downgradient/delineation monitoring wells will be installed in downgradient locations at each of these sites. These wells will serve to monitor downgradient conditions at locations that are not expected to contain HO or dioxin. At one of the downgradient well locations from each site, a pairing of shallow and deep wells is proposed. The strategic pairing of these monitoring wells provides the best way to determine the vertical potential for groundwater flow at each of these sites. The well installation details are provided in Subsection 3.3.2, Technical Specifications for Monitoring Well Construction. Vertical extent wells are designed to evaluate transport direction and extent of any potential contaminants that may be associated with these sites.

Table 3-1
Proposed Well Installation

Groundwater Monitoring Workplan
Naval Construction Battalion Center
Gulfport, Mississippi

Site	Shallow	Deep	Piezometer	Monitoring Station[1]
1	3	1	—	—
2	2	1	—	—
3	3	1	—	—
4	5	2	—	1
5	5	2	—	1
7	3	1	—	—
8	7	3	—	—
Basewide	—	—	7	—
Totals	28	11	7	2

[1] Monitoring station will evaluate surface water and groundwater interaction. A station consists of a graduated staff gauge in the ditch and a piezometer located adjacent to the gauge.

Note: All measurements are in feet.

— = no data.

Characterization monitoring wells will be installed within the boundary of the two landfills (Sites 4 and 5) and Site 8 if dioxin-contaminated groundwater is encountered above action level during the CPT study. Within this category, vertical extent wells will be paired with shallow water table wells. All of the shallow wells will have 15-foot-long screens that span the water table. The deep wells will have 10-foot-long screens set from 40 to 50 feet bls. These wells will provide for characterization of contaminant levels and changes that occur to those levels during post investigation monitoring. Monitoring wells installed on Site 8 in support of the delisting petition (ABB-ES, 1994a) will reduce the number of characterization wells on the site.

Lastly, upgradient wells will be installed to isolate potential groundwater contamination from other potential upgradient sources. The total number of wells required to meet the three stated objectives will be greatly reduced by collecting the data outlined in the CPT investigation. The three objectives are (1) characterizing and delineating dioxin in the groundwater, (2) isolating down-gradient wells that define the limits of potential groundwater contamination, and

(3) isolating individual sites from potential upgradient groundwater contamination.

3.2.2 Sites 1, 2, 3, and 7 Sites 1, 2, 3, and 7 do not have any suspected or confirmed reports of HO disposal. However, existing groundwater sample results from these sites are either upgradient or cross gradient of the disposal areas. For this reason, downgradient wells will be installed at each of the four sites. The process for activities at these sites is outlined on Figure 3-5, Project Logic Diagram for Sites 1, 2, 3, and 7.

3.2.2.1 **Phase I, Sites 1, 2, 3, and 7** Prior to the installation of downgradient wells at these sites, CPT groundwater samples will be collected at predetermined locations (Figure 3-6). If these CPT samples are below established action levels, then the downgradient monitoring wells will be installed at the locations proposed in the Phase I Summary report. If dioxin levels in the groundwater at any of these sites are above the established action level, then delineation activities will commence with the CPT. The total analyte list is provided in Subsection 3.3.3, Technical Specifications for Well Development.

3.2.2.2 **Phase II, Sites 1, 2, 3, and 7** If the dioxin levels are below action levels, Phase II activities will consist of installing and sampling the predetermined downgradient monitoring wells at the same locations of the CPT samples shown on Figure 3-6. However, if dioxin levels are above the action level, Phase II will consist of installing and sampling characterization and downgradient monitoring wells.

At one of the downgradient well locations, a pairing of shallow and deep wells is proposed for each site. All of the shallow wells will have 15-foot-long screens that span the water table. The deep wells will have 10-foot-long screens set from 40 to 50 feet bls. The strategic pairing of these monitoring wells provides the best way to determine the vertical potential for groundwater flow at each of these sites during the post installation monitoring period. This information is crucial to determine the transport directions and extent of any potential contaminants that may be associated with these sites.

3.2.3 Potentiometric Surface Monitoring Piezometers will be installed at seven locations around the base to determine the potentiometric surface and groundwater flow directions (Figure 3-7). The piezometers will be used for monitoring groundwater water levels only and will not be sampled. The requirements for piezometer construction are provided in Subsection 3.3.2, Technical Specifications for Monitoring Well Construction. As shown on Figure 3-7, three of the piezometer locations have paired piezometers, with one piezometer at the water table, and the other screened at 40 to 50 feet bls.

3.2.4 Surficial Aquifer Testing As part of the definitive basewide surficial aquifer monitoring, estimates of hydraulic conductivity, transmissivity, and groundwater flow directions will be determined. Data collection for these activities will be accomplished by performing aquifer slug tests in two wells from each of the sites. Rising-head tests will be performed in the shallow wells that are screened across the water table, and both rising- and falling-head slug tests will be performed in the deeper wells.

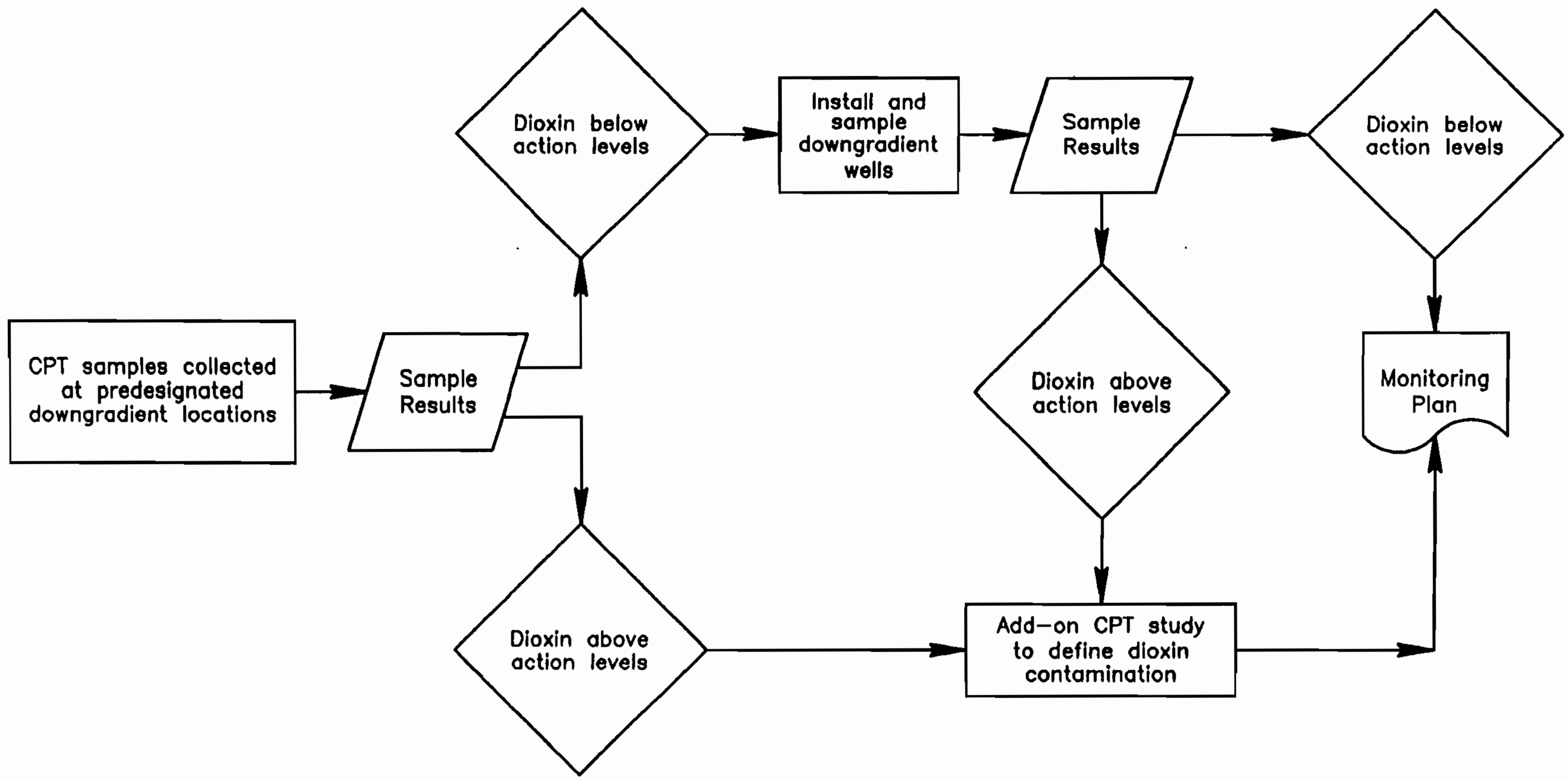

FIGURE 3-5

PROJECT LOGIC DIAGRAM
SITES 1, 2, 3, AND 7

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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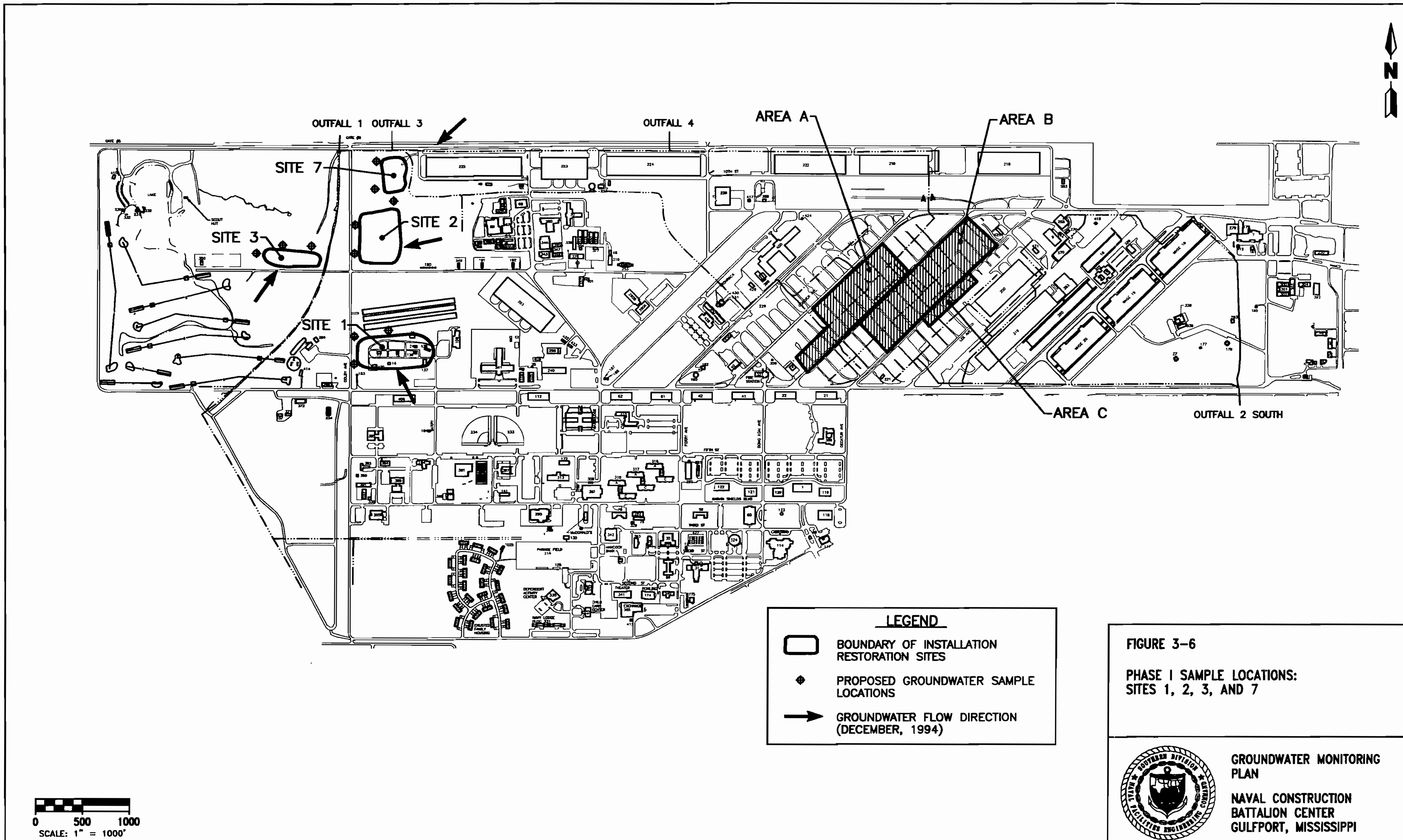

FIGURE 3-6

PHASE I SAMPLE LOCATIONS: SITES 1, 2, 3, AND 7

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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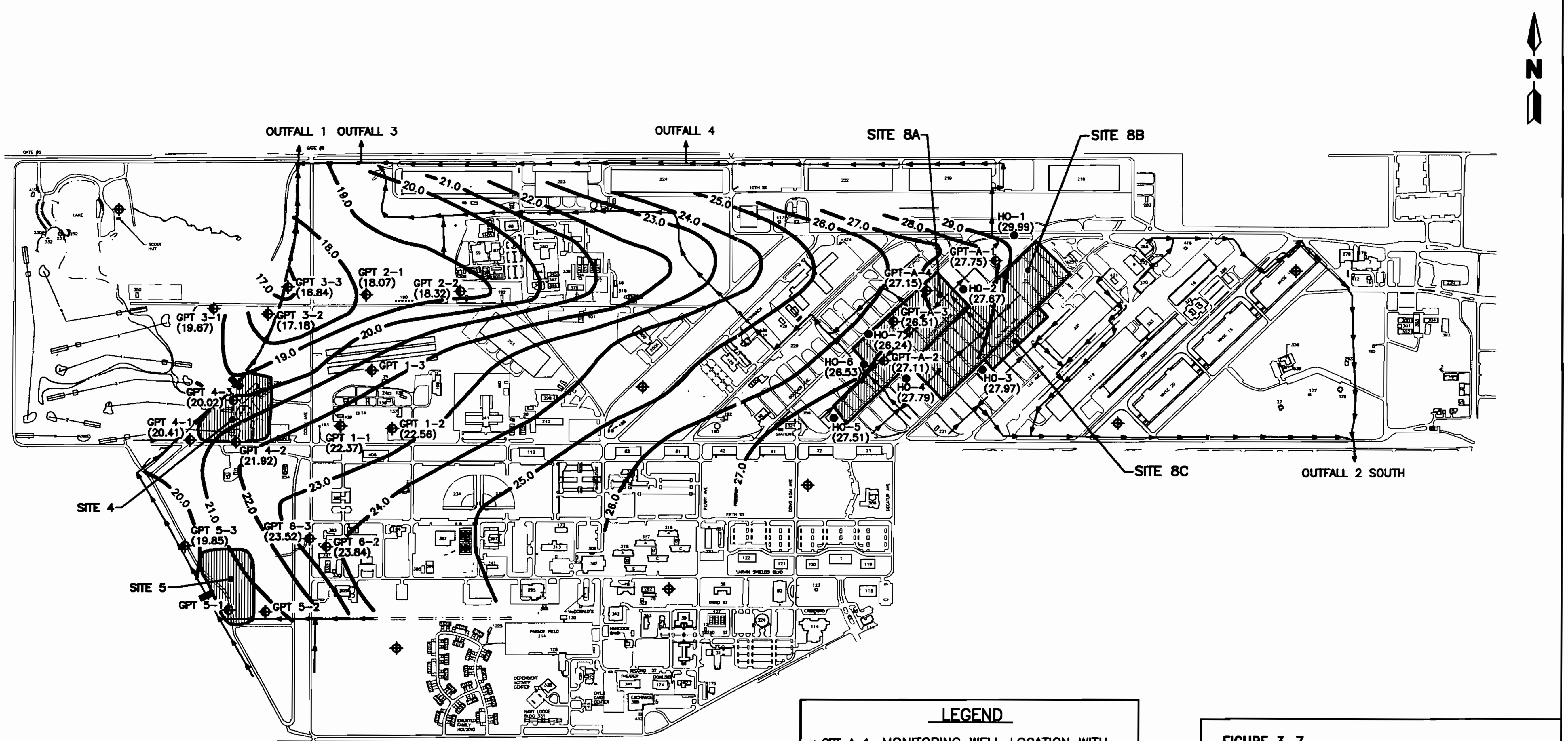

LEGEND

GPT-A-4 (27.15)	MONITORING WELL LOCATION WITH GROUNDWATER ELEVATION AS OF DECEMBER 1994
HO-1 (29.99)	WELL POINT LOCATION WITH GROUNDWATER ELEVATION
28.0	POTENTIOMETRIC SURFACE CONTOUR, 1.0' INTERVALS
⊕	PROPOSED PIEZOMETER LOCATION
▬	SURFACE WATER/AQUIFER MONITORING STATION

0 500 1000
SCALE: 1" = 1000'

FIGURE 3-7

PIEZOMETER LOCATIONS

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

D:\DWG\ABB\08535-04\GW_MON\FIG_3-7\DMF\961025

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As stated in Chapter 2.0, Site Conceptual Models, the interaction between surface water and groundwater at Sites 4 and 5 is very important in determining pathways of contaminant transport, potential receptors, and the scope of any potential remedial action that may need to be taken. For instance, if dioxin-contaminated fluids are entering the ditches at either Site 4 or Site 5, that pathway would need to be removed or cut off before sediment remediation/removal should take place.

To support evaluation of the interaction between the surface water and the groundwater in the surficial aquifer, a stream monitoring station will be placed at Site 4 and Site 5 (Figure 3-7). A station will consist of two piezometers: one set in the ditch and the other set directly adjacent to the ditch in the surficial aquifer. A graduated staff gauge will be located in the ditch adjacent to the piezometer. The piezometers will be instrumented with a low maintenance data loggers that have the capability to store data (such as the In-Situ Troll). The dataloggers will be connected via a cell modem network so data can be obtained and processed remotely. This will allow access to data during normal flow conditions as well as peak flow and rainfall events. Remote access of flow conditions will also allow for an earlier and more efficient design process for activities placed in the Interim Corrective Measures Workplan (ABB-ES, 1996g).

3.3 TECHNICAL SPECIFICATIONS. This section provides detailed specifications for field activities including cone penetrometer sampling intervals and analytical parameters, monitoring well and piezometer construction and development details, sample collection procedures and analytical parameters, decontamination procedures, and the extent of surveying requirements.

3.3.1 Technical Specifications for the CPT Investigation This subsection furnishes the details and overall approach to collecting CPT samples during Phase I of this project.

The initial CPT samples will be collected around the edges of the disposal cells, with preferential locations on the downgradient side. At least one sample will be collected from within the larger cells.

As shown on Figures 3-2, 3-3, and 3-4, the sample locations will be focused on individual cells at Sites 4 and 5 and will focus on determining the extent of groundwater contamination at Site 8. To accomplish this, the CPT will utilize the hydrocone setup to collect a groundwater sample from 3 feet below the groundwater level or the bottom of the disposal cell, whichever is deeper. Three feet below the groundwater level was chosen because of historical data from monitoring wells at Site 8 (ABB-ES, 1995e) that indicates this is the level that produces the highest and most reproducible results for dioxin-contaminated groundwater.

A second deeper groundwater sample will be collected from each of the larger cells. This sample will be collected at 10 feet below the groundwater level. This sample is necessary because of solvents potential solvent-drive conditions deeper in the surficial aquifer.

3.3.2 Technical Specifications for Monitoring Well Construction This subsection provides details for monitoring well installation and development. Details are also provided for the installation of the piezometers that will be used to determine the basewide potentiometric surface.

__Soil Borings__. Soil borings will be advanced to a depth of approximately 14 to 20 feet bls, depending on the depth to groundwater. These borings are in conjunction with the monitoring wells to be installed as outlined in Paragraphs 3.2.1.2 and 3.2.2.2.

Soil borings will be drilled using the rotasonic drilling technique. Soil samples will be collected for descriptive purposes from each boring for monitoring wells at Sites 4 and 5 and from selected delineation wells at Site 8. One soil sample from the first interval below the water level will be sent to an offsite laboratory for analysis. Monitoring wells will be installed in the boreholes upon completion.

Soil samples may be eliminated if the location has been previously sampled during another ongoing investigation.

__Well Construction__. The shallow monitoring wells will be installed to a depth approximately 10 to 12 feet below the water level.

Shallow monitoring wells shall be constructed with 2-inch inner diameter, Schedule 40, polyvinyl chloride (PVC) with flush-threaded joints. The bottom 10 feet of each shallow well shall be screened with Schedule 40 PVC, 0.010-inch slotted well screen. All PVC flush-threaded joints and well screen shall meet or exceed the water pressure ratings (at 73 degrees Fahrenheit) for the size and schedule of PVC pipe used in the project, as listed in American Society for Testing and Materials (ASTM) D1785: Table XI.2. No solvents or PVC cement shall be used in well fabrication. Typical single-cased well completion details are shown on Figure 3-8.

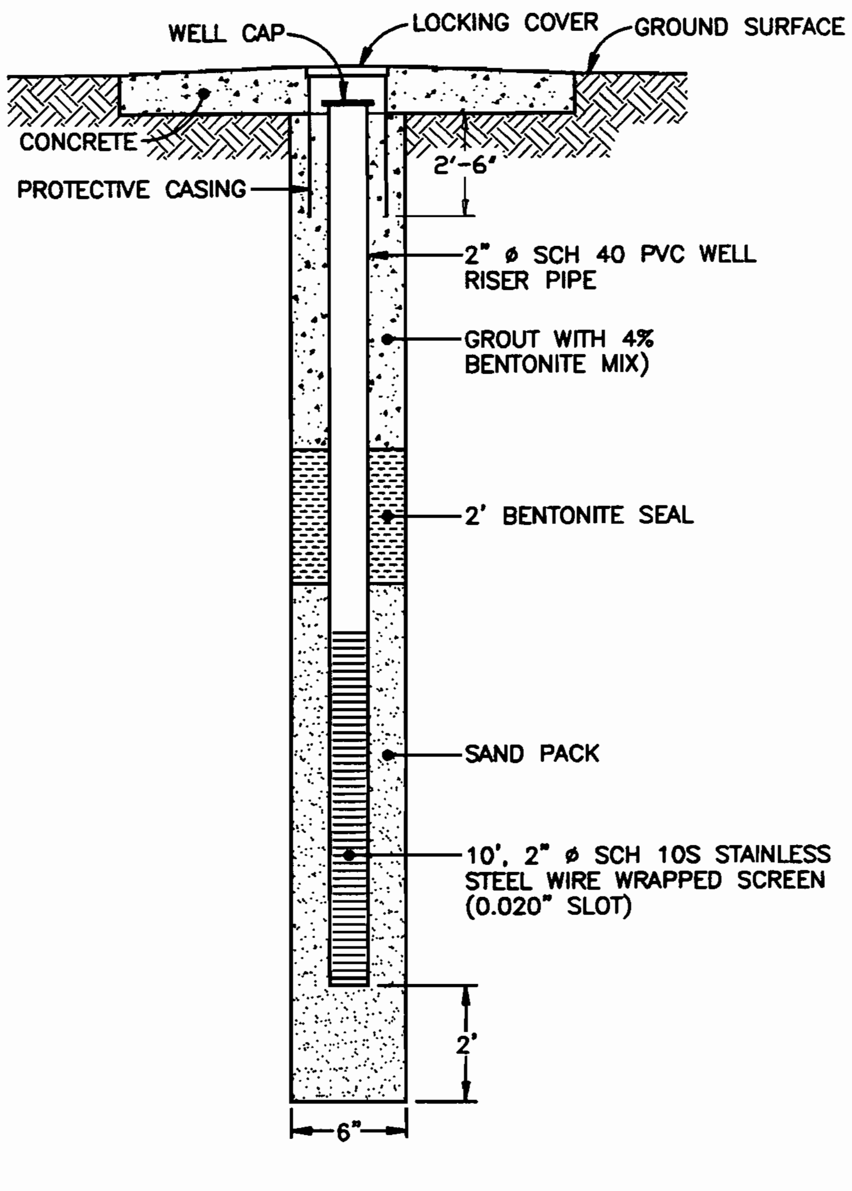
A filter pack shall be installed in the annular space surrounding the well screen and shall extend to a depth of 0.5 to 1.0 foot above the screened interval. The filter pack shall be 98 percent pure silica, cleaned with potable water, have a uniformity coefficient of 1 to 3, and a specific gravity of 2.6 to 2.7. The filter pack shall meet ASTM C 775 standard sand specifications.

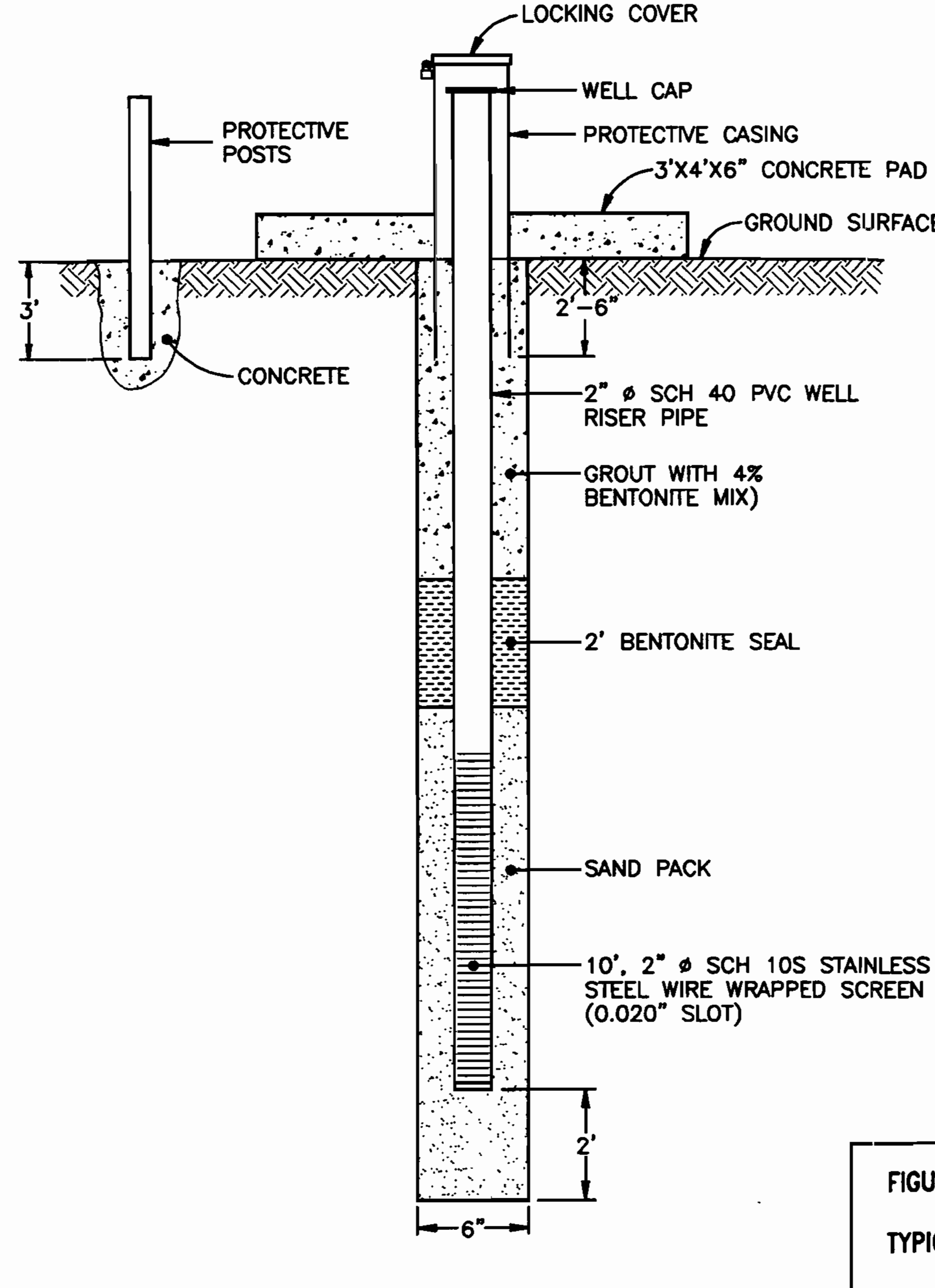
For shallow wells, a 6- to 12-inch-thick bentonite seal shall be placed in the annular space above the filter pack. The diameter of the bentonite pellets shall be 0.25 inch. Bentonite shall be 90 percent montmorillonite clay, with a bulk dry density of 80 pounds per cubic foot, a specific gravity of 1.2, and a pH of 8.5 to 10.5. If granular bentonite is used, it shall conform to American Petroleum Institute standard 13-A for bentonite. The bentonite seal shall be allowed to hydrate the time period specified by the manufacturer.

The remaining annular space above the bentonite seal shall be grouted to surface with Portland cement conforming to ASTM C 150 Type 1.

Accurate measurements will be made to the top of the filter pack and bentonite seal with a weighted tape and adjusted to reflect the top of casing.

Wells will be protected with steel, traffic-bearing vaults installed flush to the existing grade. Wells will be supplied with locking expansion plugs with keyed-alike, corrosion resistant padlocks. A 2-foot by 2-foot, 6-inch-thick concrete





NOT TO SCALE

FIGURE 3-8

TYPICAL MONITORING WELL ILLUSTRATION

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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pad will be installed around the traffic bearing vault of each monitoring well. The concrete will be installed so that surface runoff does not pond around the well casing and protective cover. The concrete mix will obtain a minimum 28-day compressive strength of 3,000 pounds per square inch.

<u>3.3.3 Technical Specifications for Well Development</u> Following monitoring well installation, each well will be developed. The selected method will be capable of removing all drilling fluids and cuttings from inside the well, within the filter pack and from within the formation. The development method will not introduce any type of contamination into the aquifer. No air or water will be injected into the wells during development. Each well will be developed by removing a minimum of 10 well volumes, until the water is clear and free of apparent turbidity, and until the physical parameters such as pH, temperature, conductivity, and turbidity stabilize to within 10 percent. At well locations with very slow recharge or little water, wells will be developed dry a minimum of three times.

The preferred procedure for development follows:

- vigorous use of a surge block over the entire screened interval;
- initial pH, temperature, and conductivity readings;
- removal of bulk fines and fluids with vacuum lift pump (centrifugal or bladder pump);
- recollection of physical parameters every three to four well volumes; and
- repeat steps until physical parameters stabilize to within 10 percent of the previous readings after 10 well volumes have been removed.

A note here regrading turbidity: Several of the wells onbase have problems with high turbidity. The turbidity is the result of the wide range in grain sizes in the surficial aquifer, including a high percent of organic-rich fines in some locations. The filter packs for the new monitoring wells will be designed to handle the fines better than previous wells, but turbidity could still pose a problem. If all procedures for well development have been executed and the physical parameters have stabilized to within 10 percent, then development should be halted to keep the amount of development fluids to a minimum.

<u>3.3.4 Technical Specifications for Sample Collection</u> Two environmental media will be sampled during execution of this workplan: subsurface soils and groundwater. The sections that follow describe the procedures for collecting and logging each type of sample.

<u>Subsurface Soil Sample Collection</u>. Subsurface soil samples will be collected during soil borings with a rotasonic drill rig. The method outlined here is modified from ABB-ES Field Method Sheets (ABB-ES, 1996h). Please see Field Method Sheets 4.C.5.28, 4.C.5.30, and 4.C.5.52 for a complete description of activities associated with this type of sampling. In general, the following items encompass the order of activities: (1) collect the desired interval from the core, (2) place the sample section on clean plastic, (3) screen the sample

with a flame ionization detector (FID), (4) collect the volatile sample, and (5) composite the remaining sample section volume for the other sample containers.

As always, special care must be taken while collecting samples for high resolution dioxin and furan analysis. These precautions include (but are not limited to) (1) using properly decontaminated sampling equipment that is completely wrapped in foil (See Subsection 3.3.5, Technical Specifications for Decontamination), (2) using sample jars that are specifically intended for dioxin analysis, (3) discarding sample jars that are damaged or have a general dusty or old appearance, (4) wearing gloves at all times (never use bare hands) when handling sampling equipment or open sample jars, and (5) changing gloves frequently during the sample collection (e.g., at a minimum: just prior to handling sample volume for placement in sample jars and immediately after placement).

Groundwater Sample Collection. Groundwater samples will be collected from all newly installed monitoring wells. Samples will not be collected from any of the new piezometers. It is expected that all the wells will be properly developed before initiating the following procedures for groundwater sample collection. The Method Sheets (ABB-ES, 1996h) associated with this activity include sheets 4.C.5.36 through 4.C.5.44. The tasks described by the Method Sheets and the general order for completing groundwater sampling are (1) open and screen the well head, (2) measure water level and water-column height, (3) determine well volume and total purge volume, (4) purge well and collect physical parameters, and (5) collect the groundwater sample.

Again special precautions should be taken because of the potential contaminant and the high resolution dioxin and furan analysis. These precautions include (1) placing plastic sheeting around the well in the working area, (2) wearing dermal protection to protect against splashing, (3) properly decontamination and wrapping sample equipment (see Subsection 3.3.5, Technical Specifications for Decontamination), (4) using only sample jars specifically intended for aqueous dioxin samples, and (5) changing gloves between samples and when handling equipment.

3.3.5 Technical Specifications for Decontamination This subsection describes the procedures to be used for decontamination of sampling equipment, drilling equipment, construction materials, and personal decontamination.

Sampling Equipment. Where possible, the field crew will transport sufficient equipment so that the entire collection interval can be conducted without the need for field decontamination. However, when this is not possible, the field decontamination procedures described below will be followed (ABB-ES, 1993b).

Teflon™, stainless-steel, or glass sampling equipment will be used to collect the samples and will be decontaminated between sample locations as listed below.

1. Wash and scrub equipment with laboratory detergent and tap or deionized water.
2. Rinse thoroughly with organic-free deionized water.
3. Rinse twice with nonpolar solvent (pesticide-grade isopropanol). Important because dioxin is not soluble in water.

4. Rinse with organic-free deionized water and allow to air dry for as long as possible.

Drilling and Cone Penetrometer Equipment. All equipment that comes onsite or in contact with potentially contaminated soils or water will be decontaminated before entering the site and after each use. Decontamination will consist of steam pressure cleaning, detergent washing, and tap-water rinsing. Split-spoons used for chemical analysis should be cleaned with cleaned with Alconox® and a brush, rinsed with potable water, rinsed with deionized water, rinsed twice with solvent (pesticide-grade isopropanol), rinsed with organic-free water and allowed to air dry, then wrapped in foil.

After each use, the equipment shall be taken back to the decontamination area and cleaned. Decontamination will only be permitted at the approved decontamination area. Only split-spoon samplers and CPT sampling equipment may be decontaminated at the location of the CPT or well boring if reuse is necessary. In this case, steamcleaning of split spoons or CPT rods will not be required.

Construction Materials. All materials to be used to construct monitoring wells shall be steamcleaned before operations unless completely contained in factory plastic wrapping prior to use. Steamcleaning must be performed at the decontamination area and may be performed during equipment decontamination. After materials are decontaminated, the materials will be handled and stored in such a manner (enclosed in new clean plastics) to prevent cross contamination or recontamination.

Personnel Decontamination. Personnel decontamination procedures, as specified in the Health and Safety Plan (ABB-ES, 1993b), will be followed at each sampling location before personnel leave the sampling area. These procedures will be enforced during all aspects of work including (1) the CPT investigation, (2) monitoring well drilling and installation, and (3) groundwater sampling.

3.3.6 Technical Specifications for Surveying Several reference points will have to be surveyed in the landfills at Sites 4 and 5 prior to the initiation of the CPT study. These reference points will allow for accurate placement of the initial samples. Only horizontal references (northings and eastings) will be required for the CPT study. Preinvestigation survey data will not be required at Site 8 due to the presence of surveyed monitoring wells and well points. The preselected CPT points at Sites 1, 2, 3, and 7 will not require surveyed locations either.

3.4 CONTROL AND DISPOSAL OF IDW. The IDW will be segregated by medium and stored in 55-gallon drums. Labels describing the content of the specific container (soil or water) and the date of generation will be attached to the drums. The drums will then be placed on pallets.

Personal protective equipment and other disposable items (Visqueen™, disposable equipment, etc.) will be washed and scrubbed to remove debris, double bagged, and disposed of in NCBC waste containers.

At the end of the field investigation, the IDW will be characterized by sampling the waste for TCLP dioxin analyses. Based on these results, the storage containers will then be labeled as "nonhazardous," "solid waste," or "hazardous waste."

The laboratory results will be used to determine the final disposition of the containerized IDW. A copy of the laboratory analytical reports will be stored onbase so that comparisons of the results and IDW classification and disposition can be made by base environmental personnel.

<u>3.5 HEALTH AND SAFETY PLAN</u>. This field investigation will utilize the Health and Safety Plan developed for the RI/FS (ABB-ES, 1993b) for NCBC Gulfport.

CHAPTER 4.0

4.0 ANALYTICAL PROGRAM

This chapter outlines the analytical data management program for chemical and geotechnical data to be collected during onsite delineation activities at the NCBC. The analytical program includes the development of data quality objectives (DQOs) for the program; identification of laboratory methodology for sample analyses; procedures for data assessment, including data validation procedures; and procedures for data management. All procedures and methodology included in this analytical program are consistent with those outlined in the Remedial Investigation and Feasibility Study SAP for NCBC Gulfport (ABB-ES, 1993b).

4.1 LABORATORY ANALYSIS. As discussed in Chapter 3.0, environmental samples will be collected from two types of media: soil and groundwater. Groundwater samples will be collected for chemical; soil samples will be collected for chemical and geotechnical analyses. The following subsections identify analytical methods to be followed for each type of sample analysis to be performed.

4.1.1 Chemical Analyses Grab samples collected from groundwater and soil, along with associated quality control (QC) samples, will be analyzed for chlorinated herbicide compounds, polychlorinated dibenzo-p-dioxins, and polychlorinated dibenzofurans. All soil samples will also be analyzed for TOC. In addition, groundwater samples will be analyzed for volatile organic, semivolatile organic, pesticides, and PCBs (USEPA, 1994a) analytes. These additional analytes are required to determine probable fate and transport of dioxin in groundwater, as well as through possible sources of dioxins.

Groundwater and soil chemical analysis for the chlorinated herbicides will be in accordance with USEPA SW-846 Method 8150B (USEPA, 1986b). Chemical analysis for polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans will be in accordance with USEPA SW-846 Method 8290 (USEPA, 1986b). Chemical analysis of volatile organics, semivolatile compounds, and chlorinated pesticides and PCBs will be in accordance with USEPA's Contract Laboratory Program Statement of Work (USEPA, 1992). TOC analyses will be performed according to USEPA SW-846 Method 9060. Holding times and preservation requirements associated with each of these analytical methods are presented in Table 4-1. Target compound lists and corresponding practical quantitation limits for the above analytical methods are contained within Remedial Investigation and Feasibility Study Volumes I and II (ABB-ES, 1993b) and Technical Memorandum No 1 (ABB-ES, 1994A).

4.1.2 Physical and Geotechnical Analyses Groundwater samples collected in support of onsite remediation activities will be analyzed for total dissolved solids (TDS), total suspended solids (TSS), dissolved oxygen (DO), and oxidation/reduction potential (ORP). TDS and TSS will be analyzed in accordance with USEPA Methods 160.1 and 160.2, respectively (USEPA, 1983). DO will be analyzed in the field using the Winkler titration method. ORP will also be analyzed in the field using an Orion 250A meter and ORP probe.

Soil samples collected in support of onsite remediation activities will be analyzed for the following: sieve analysis by ASTM Method D-421, hydrometer analysis by ASTM Method D-422, Atterberg limits by ASTM Method D-4318, bulk density by ASTM Method E12-70, cation exchange capacity by USEPA SW-846 Method 9081, and pH by USEPA SW-846 Method 150.1. (ASTM, 1985; USEPA, 1986b). Holding

Table 4-1
Summary of Holding Time and Preservation Requirements

Groundwater Monitoring Workplan
Naval Construction Battalion Center
Gulfport, Mississippi

Chemical Parameter	Analytical Method	Preservation	Holding Time (from date of sample collection)	
			Soil	Groundwater
Volatile organic compounds	USEPA CLP	Cool, 4°C 4 drops concentrated HCl	–	14 days
Semivolatile organic compounds	USEPA CLP	Cool, 4°C	–	7 days extraction 40 days analysis
Organochlorine pesticides and PCBs	USEPA CLP	Cool, 4°C	–	7 days extraction 40 days analysis
Chlorinated herbicides	SW 8150B	Cool, 4°C	14 days extraction 40 days analysis	7 days extraction 40 days analysis
Dioxins and furans	SW 8290	Cool, 4°C	30 days extraction 45 days analysis	30 days extraction 45 days analysis
Total organic carbon	SW 9060	Cool, 4°C H_2SO_4 to pH <2	28 days	–
Total dissolved solids		Cool, 4°C	–	7 days
Total suspended solids		Cool, 4°C	–	7 days
Dissolved oxygen		None	–	Immediately upon collection
Oxidation/reduction potential		None	–	Immediately upon collection
Sieve analysis		None	None	–
Hydrometer analysis		None	None	–

Notes: USEPA CLP = U.S. Environmental Contract Laboratory Program (1992).
°C = degrees Celsius.
HCl = hydrochloric acid.
– = no data.
PCB = polychlorinated biphenyl.
H_2SO_4 = sulfuric acid.
< = less than.

times and preservation requirements associated with these analytical methods are presented in Table 4-1.

4.2 DQOs. DQOs for the analytical program were developed to provide data of sufficient quality to support decisions associated with site conditions. The USEPA has defined five DQO levels that correspond to the intended uses of the analytical data (USEPA, 1994b). Tasks for onsite delineation activities at NCBC Gulfport will involve data collection with DQOs ranging from USEPA Level I to Level V. Level I data to be collected will provide qualitative information regarding air quality (for health and safety purposes) and aquifer stabilization during well purging. Level III data to be collected will provide quantitative information used to characterize site conditions, but do not require data validation. Level IV data collected will provide the highest quality of analytical information used to characterize site conditions and support risk assessment activities. Level IV data are required to be validated according to USEPA guidelines. Level V data collected will provide information used to support future remedial action alternative evaluations and support future engineering design. Table 4-2 summarizes the DQO levels for each type of datum that will be collected during field activities and lists the current and potential future uses associated with each data set.

NEESA has adopted QC levels for sample collection, analysis, and data validation that, when followed, provide data of sufficient quality to meet required DQOs (NEESA, 1988). NEESA QC levels C, D, and E correspond to USEPA DQO levels III, IV, and V, respectively (USEPA, 1994b). In order to meet the required DQOs, investigative samples will be collected and analyzed in accordance with NEESA guidance using standard USEPA-accepted techniques and protocols. As presented in Section 4.1, only USEPA-accepted analytical methods were selected for Level III and Level IV sample analyses. In addition to selecting the appropriate sampling and analysis protocols, certain QC samples must be collected during sampling activities to meet the required DQOs. A brief description of QC samples and frequency of collection is presented below. Selected definitions were obtained from USEPA Region IV Standard Operating Procedures (USEPA, 1991a) and NEESA guidance (NEESA, 1988).

Field Duplicate Samples. Field duplicate samples are two or more samples collected simultaneously into separate containers from the same source under identical conditions. Analytical data generated from the collection and analysis of field duplicate samples are intended to assess the homogeneity of the sampled media and the precision of the sampling protocol. Field duplicate samples will be collected at a frequency of 10 percent per sample matrix for Level III and Level IV analyses. Field duplicate samples will be collected at a frequency of 5 percent for groundwater and soil Level V analyses.

Matrix Spike and Matrix Spike Duplicate (MS/MSD) Samples. MS/MSD samples are additional samples collected in the field from a single sampling location. Analytical data generated from the collection and analysis of MS/MSD samples are intended to assess the precision and accuracy of laboratory procedures. One set of MS/MSD samples will be collected at a frequency of 5 percent per sample matrix for Level IV analyses. Collection of MS/MSD samples for Level III and Level V analyses are not required. However, in accordance with laboratory methodology, laboratory precision and accuracy for Level III analyses will be measured using internal QC procedures.

Table 4-2
Summary of Data Quality Levels, Analyses, and Data Uses

Groundwater Monitoring Workplan
Naval Construction Battalion Center
Gulfport, Mississippi

DQO Level	NEESA DQO Level	Type of Analysis	Data Uses	Validation
I	—	Organic vapor screening pH Specific conductivity Temperature	Health and safety monitoring Qualitative site characterization Well development and groundwater sampling	Not required
III	C	TOC analyses	Indicator parameter for dioxin Aquifer characterization Evaluation of remedial future alternatives Future engineering design	Not required
IV	D	Chlorinated herbicide analyses Dioxin/furan analyses	Aquifer characterization Risk assessment Evaluation of remedial alternatives Future engineering design	Yes
IV	D	Volatiles, semivolatiles, and Pesticides/PCBs	These chemicals may be important to determine origin and fate of dioxin in groundwater and soil	Yes
V	E	Geotechnical analyses of soils	Properties of aquifer matrix affecting groundwater flow Evaluation of remedial alternatives Engineering design	Not required

Notes: DQO = data quality objective.
NEESA = Naval Energy and Environmental Support Activity.
RFI = Resource Conservation and Recovery Act Facility Investigation.
– = no data.
TOC = total organic carbon.
PCBs = polychlorinated biphenyls.

Equipment Rinsate Blanks. Equipment rinsate blanks are collected by running deionized, organic-free water over and/or through sample collection equipment after it has been decontaminated. Analytical data generated from the collection and analysis of equipment rinsate blanks are used to assess the quality of decontamination procedures and to monitor potential cross contamination that impacts the representativeness of the investigative data set. Rinsate blanks must be analyzed for the same parameters associated with Level III and IV data.

Equipment rinsate blanks will be collected at a frequency of one every other day per type of sampling tool used. This frequency was modified from the frequency stated in NEESA guidance. NEESA guidance requires that rinsate samples be collected daily, but analysis is only required on every other rinsate collected. If analytical results for blanks indicate the presence of site-related contaminants, then all rinsate samples collected must be analyzed. However, this approach is not feasible because the turn around time for sample results rarely provides enough time to extract archived samples before holding times are exceeded. The modified approach to rinsate collection has been accepted by USEPA and SOUTHNAVFACENGCOM and is considered standard protocol.

Source Water Blanks. Source water blanks include a complete set of samples collected from each water source used in the investigation. Analytical data generated from the collection and analysis of equipment rinsate blanks should account for potential artifacts that could be introduced through decontamination, which impacts the representativeness of the investigative data set. One set of samples from each water source will be collected at the beginning of each sampling event. Source water blanks must be analyzed for the same parameters associated with Level III and IV data.

4.3 DATA QUALITY ASSESSMENT. DQOs are based on the premise that different data uses require different levels of data quality. Data quality refers to the degree of uncertainty with respect to precision, accuracy, representativeness, completeness, and comparability (PARCC). NEESA outlines data set deliverable requirements for each DQO level (NEESA, 1988). Based on the intended use of the Level III and Level V data to be collected during onsite delineation activities, laboratory deliverables will be reviewed by the project chemist for adherence to the specified analytical method, data completeness, and precision. Data precision for Level III and Level V data will be measured by evaluating field duplicate sample results and laboratory QC results, if applicable. To meet Level IV DQOs for this project, Level IV laboratory data must be validated according the USEPA guidelines and assessed to determine the validity of the data set. The following subsections discuss the data validation procedures to be followed for Level IV data and define the data quality indicators that are required to be assessed.

4.3.1 Level IV Data Validation Validation of data is a systematic process of reviewing a body of data to provide assurance that the data are adequate for their intended use. The useability of Level IV data generated during this investigation will be determined by evaluating the data against criteria and procedures established by the USEPA, NEESA, and method-specific quality assurance and quality control (QA/QC) guidance. In general, USEPA and NEESA guidelines provide a systematic procedure for evaluating laboratory QA/QC measures such as holding times, blank analyses, surrogate recoveries, MS/MSD results, instrument calibration, compound identification, and method performance.

Upon receipt, Level IV data packages will be validated according to USEPA Level IV (NEESA Level D QC criteria) and QA/QC criteria specified by each analytical method. These criteria are described in Subsection 7.3.1 of NEESA Document 20.2-047B (NEESA, 1988). The USEPA *National Functional Guidelines for Organic Data Review* (USEPA, 1991b) will also be used, where applicable, to validate the laboratory data. Validated data will be prepared in three initial formats: raw laboratory data, data marked with validation qualifiers or annotations, and corrected or validated data. The validated data can then be used for groundwater contaminant characterization of these target areas and basewide groundwater flow assessment.

4.3.2 PARCC Parameter Evaluation The acceptance criteria for PARCC parameters for Level IV DQOs outlined in this subsection are consistent with the QC requirements of the USEPA SW-846 analytical methods chosen and USEPA guidelines for data review.

Precision. Precision is defined as the agreement among individual measurements of the same chemical constituent in a sample, obtained under similar conditions. Precision objectives for analysis of site samples will be measured using field duplicates samples (including matrix spike duplicates). Acceptance criteria for field duplicate precision for Level IV DQOs have been set at 30 and 50 for aqueous and solid analyses, respectively. Acceptance criteria for laboratory duplicate precision for Level IV DQOs have been set at 20 and 35 for aqueous and solid analyses, respectively.

The precision criteria to be used for matrix spike duplicates are compound-specific and will be consistent with the QC requirements of the chosen USEPA SW-846 Methods. Precision will be shown as a relative percent difference (RPD) where

$$RPD = |X1-X2| / \frac{X1+X2}{2} * 100 \tag{1}$$

where:

RPD = relative percent difference between results
X1 and X2 = results of duplicate analysis
|X1-X2| = absolute difference between duplicates X1 and X2.

Precision objectives apply to both field and laboratory duplicates. However, field duplicates based on the analytical results take into account the level of error introduced by field sampling techniques, field conditions, and analytical variability. The RPD of all laboratory duplicates will be reported by the laboratory, and the RPD of field duplicates will be calculated to evaluate the sample precision.

Accuracy. Accuracy is defined as the degree to which the analytical measurement reflects the true concentration level present. Accuracy will be measured as percentage recovery for matrix spikes as the primary QC criterion and percentage recovery of surrogate spikes as a secondary QC criterion. The acceptance criteria for data meeting Level IV DQOs will be designated by the laboratory based on their historical performance for each analytical method used and method-specific QC criteria.

A matrix spike is a sample (of a particular matrix) to which predetermined quantities of standard solutions of certain target analytes are added prior to sample extraction and/or digestion and analysis. Samples are split into replicates, one replicate is spiked, and both aliquots are analyzed.

Accuracy can also be evaluated using the recovery of surrogate spikes in the organic analyses. These spikes consist of organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards, and samples prior to analysis.

Percentage recoveries of the surrogate and matrix spikes will be reported by the laboratory for all analyses with the samples. The percentage recovery of the spikes can be calculated from the following equation:

$$\text{Percentage recovery} = (X-B)/T * 100 \tag{2}$$

where:

X = measured amount in sample after spiking
B = background amount in sample
T = amount of spike added.

Representativeness. Representativeness expresses the degree to which sample data depict an existing environmental condition. Representativeness is accomplished through proper selection of sampling locations and sampling techniques and collection of a sufficient number of samples. The sampling locations for this investigation will be chosen in a biased approach based on previous analytical data, screening data collected in the field, and apparent and measured flow directions.

Sampling and analytical protocols were chosen so that measurements of samples will be as representative of the media and conditions being measured as possible. Sample collection, handling, and documentation will be performed in accordance with USEPA Region IV Standard Operating Procedures (USEPA, 1991a) to ensure that collection and handling techniques do not alter the sample and to provide an adequate tracking mechanism from the time of collection through laboratory analysis.

The collection and analysis of field blanks, trip blanks, and equipment rinsate blanks and conformance with requirements for analytical methods, such as extraction and analysis holding times, and analysis of method blanks will also be used to ensure representativeness of sample data.

Completeness. Completeness is a measure of the amount of valid data obtained compared to the amount of data originally intended to be obtained. The completeness goal for DQO Levels III, IV, and V has been chosen as 90 percent.

Comparability. Comparability reflects the confidence with which one data set can be compared with other measurements and the expression of results consistent with other organizations reporting similar data. In general, comparability can be determined by comparing data from replicate split samples that are analyzed by two separate contract laboratories. However, for this investigation, analysis of split samples is not required. Comparability for this investigation will be accomplished through the use of standard, USEPA-approved techniques and procedures for sample collection, handling, analysis, validation, and reporting.

4.4 DATA MANAGEMENT. Data management encompasses the collection and documentation of analytical and physical data, production and maintenance of an electronic database, and manipulation of this database for characterization of site conditions. The procedures outlined in this plan are designed to accomplish these tasks while maintaining the integrity of the original data.

4.4.1 Project Responsibilities Data management is the concern of the data manager (DM), whose tasks may range from oversight of the data management process to comprehensive, technical responsibilities. Having the DM onsite during the onbase, offbase, and Interim Corrective Measures field activities assures data integrity and security while streamlining the collection, analysis, and reporting of data. The DM is responsible for the oversight or conduct of the following tasks:

- data management planning and development of the Data Management plan
- data collection and documentation
- sample tracking
- data compilation and QA/QC of documentation
- database training and certification confirmation
- data transfer and upload to the project database
- editing the database
- querying the database and downloading data
- selection and use of applications software
- data transfer and reporting
- system verification
- security
- backup and archiving
- required equipment, software, and supplies

4.4.2 Data Management System ABB-ES will use a real-time interpretation system of integrated softwares for the storage and manipulation of physical and chemical data collected at the base. Two databases will be used: the sample tracking database and the project database. The sample tracking database contains sample data and physical site data. The sample tracking database is used to mesh data from several sources into import files for uploading into the project database. The project database is a geographic information system (GIS) that will allow the storage and analysis of spatial and scalar site data in both graphical (charts and maps) and tabular formats.

The sample tracking database will allow the DM to track the sampling and data collection effort by recording specific milestones, sample data for each sample taken, and physical data. It also contains requisite reference tables of data including sampling method protocols and sampling schedule data. Macros for importing and exporting data as well as easing data manipulation (i.e., creation of sample jar labels and meshing reference information with entered sample information) have been imbedded within the workbooks. The sample tracking database will allow the project team to assess the sampling program, report on progress and problems encountered, and recommend future actions on a real-time basis. This instant access to sample information increases project efficiency and flexibility by allowing the team to modify the sampling plan, as needed, to meet project goals.

The project database will utilize a GIS to store the data in a spatial format, allowing data to be outputted in a variety of graphical (maps, videos, and charts) and tabular formats. Real-time analysis will be available due to the fact that data are uploaded into the project database upon receipt. This will allow the project team to coordinate their efforts and streamline sampling events and locations by utilizing a constantly updated and refined conceptual model of the site. Upon completion of the field program, further analysis of the entire data set or subsets will continue. The project database will consist of the fields included in the standard import templates provided by the GIS software, with the exceptions and constraints that follow.

- The project database will not be used to track fixed-base laboratory QA/QC samples or surrogate data, nor will the database be used to relate equipment rinsate blanks to fixed-base laboratory primary samples.
- All sample results will account for dilution.
- All soil results will account for soil moisture.
- The project database will not be used to track multiple test runs from the fixed-base laboratory.
- Chemical data fields that are not applicable to this project, as determined by the DM and the technical lead, will not be completed.

Use of this system is designed to

- provide consistency in data management procedures;
- minimize time spent on database construction and operation;
- minimize data transcription and associated errors;
- reduce costs associated with the maintenance and use of multiple project databases;
- allow for efficient storage, presentation, and transfer of environmental data; and
- provide real-time analysis of site conditions to increase project efficiency.

Utilizing an integrated set of software programs and operating system will allow the project team to efficiently collect, store, and manipulate data collected at the base. The basic structure of the system has been previously developed by ABB-ES and will be used for the onbase, offbase, and Interim Corrective Measures activities. Table 4-3 lists the equipment, computer operating system, and software that are required.

4.4.2.1 **System Security** Security measures will consist of protecting original documentation, establishing system passwords, using antivirus protection software, and assigning/limiting database access rights. Documentation protection, password setup for personal computers, and antivirus protection will be initiated

Table 4-3
Equipment List

Groundwater Monitoring Workplan
Naval Construction Battalion Center
Gulfport, Mississippi

Equipment	Purpose
One Intel™ Pentium-based PC with a minimum of 24 MB of RAM, and sufficient disk space for requisite software, word processing, and graphics production.	Sample tracking database repository.
One Intel™ Pentium Pro-based PC with a minimum of 32 MB RAM, and sufficient disk space for requisite software, word processing, statistical analysis, and graphics production.	Project database repository.
Two Intel™ 486 pen-based field computers with sufficient disk space for requisite software and data storage	To be used by sample teams for electronic data collection (sampling and boring data and coordinates [i.e., latitude and longitude]).
One Hewlett-Packard™ Laser Jet Series IV printer (600 dots per inch [dpi]), or equivalent	For printing paper copies of data, charts, maps, and reports.
Two copies of Microsoft® Windows NT™ operating systems	Operating system with built-in networking ability to allow all computers to work together seamlessly. Also allows increased data processing speeds due to true 32-bit architecture.
Two copies of Microsoft® Excel™	Essential for data manipulation and transfer between databases. Contains sample tracking database.
One copy of Microsoft® FoxPro™ 2.5 or higher for Windows	Contains the project database.
One copy of AutoCAD® Release 12	Essential for graphically presenting the geographic and spatial information contained in the project database.
One copy of GIS/Key™ Environmental Data Management Software, Release 2.1 or higher	Provides the project database structure and seamless interface with associated software.
One copy of Quicksurf™ release 5.1 or higher	Essential for interpreting spatial data contained in the project database.
Two copies of Microsoft® Backup, Winzip™, or other backup software and requisite disks, tapes, or removable hard drives	Provides the project team with a backup copy of the project database.
Two 28.8 kilobyte per second modems or higher and associated software	Allows data, report, and deliverable transfer to offsite personnel for input, analysis, and review.
Microsoft® Word™	Used to prepare reports and deliverables, as well as sampling labels.
Two copies of antivirus software, such as Norton™ Antivirus for Windows or McAfee™ Antivirus	Provides computer virus protection for the project data (updated regularly).

Notes: This equipment will be used onbase, offbase, and during Interim Corrective Measures activities. All software will be compatible with the Windows™ NT operating system.

PC = personal computer.
MB = megabyte.
RAM = random access memory.
™ = trademark.
GIS = geographic information system.

by the DM. Database access rights will be granted by the DM and limited to the minimum allowable individuals required to maintain and operate the sample tracking and project databases and applicable software. These individuals will be required to possess a minimum knowledge of, or undergo training in, all of the software to which they have been assigned to use.

All electronic files will be transferred between the field computer, the sample tracking database, and the project database via floppy disk, modem, or serial connection. Manually entered data will be limited to the field electronic forms and the sample tracking database (data from field paper forms and survey data manipulation). Cross referencing of data files will be used for data verification and error checking.

4.4.2.2 **System Backup** Data collection documents will be copied and the original materials returned to the project file. The copies will serve as a backup in the unlikely event the original documents are lost or destroyed.

Electronic files constructed for uploading data to the sample tracking or project databases and files used in the collection, compilation, or data interpretation phases of this project will be backed up to floppy disks or tape on an as-needed bases, as determined by the DM. The sample tracking and project databases will be backed up automatically to an external tape drive, daily.

4.4.3 Data Management Procedures The data management system is constructed and will be operated using the following generalized procedures:

- development of the sampling plan;
- development of the electronic sample tracking database using Microsoft® Excel™;
- printout sample jar labels and download sample information to field computers;
- collection (utilizing electronic data forms), in the field, of analytical sample information for electronic import into the sample tracking system;
- collection (utilizing paper or electronic data forms), in the field, of geologic and hydrologic data for import into the sample tracking system;
- electronic compilation of geologic and hydrologic data with the sample tracking database for construction of project database physical import templates;
- electronic compilation of fixed-base analytical data with the sample tracking database for construction of project database analytical import templates;
- electronic upload of physical and analytical data into the project database; and

- production of real-time reports, graphics, and technical memoranda using the GIS-integrated software (Microsoft® FoxPro™, AutoCAD™, Quicksurf™, etc.), Word™, and Excel™.

4.4.3.1 **Project Initiation** Prior to project kickoff, a sampling plan will be developed by the DM, the field operations leader, the project team leader, and the project technical lead. The sampling plan will determine locations to be sampled, sample identification nomenclature, sampling methods, and sampling schedules. All information from the sampling plan will be input into the sample tracking database, including reference tables, prior to project kickoff. Modifications to the sampling plan during the project will be documented and effected by the field operations leader and the DM upon the approval of the project team leader and technical lead.

Project database initialization includes preparation of a base map and drawing templates, installation of project files, development of lists and codes for construction of the project database, identification of the types of data to be uploaded into the project database, and identification of data analysis procedures. Lists and codes developed in the sampling plan will be added to the project database prior to uploading data and as the project progresses. The routines for the setup of the base map and installation of project files, as defined in the software user guide, will be followed. The drawing template for maps will be copied for the base map and provided with a border, scale, legend, and north arrow for the construction of report figures. Any additional templates, such as geologic cross sections, will be constructed on an as-needed basis.

4.4.3.2 **Sample Tracking** The sample tracking database will include all data necessary for tracking the analytical and physical data for the site prior to upload into the project database. The sample tracking database will consist of an Excel™ Workbook containing spreadsheets and requisite macros for error checking and data manipulation, import, and export. Additional reference tables and macros may be contained within auxiliary Excel™ workbooks. As sample and physical data becomes available, it is either electronically uploaded or manually entered. Manually entered data has been minimized and electronic error checking has been included to reduce errors associated with data transfers. Database security will be provided by three levels of access with password verification. The sample tracking database will be backed up daily and the backups will be stored for 2 weeks in a fire-safe vault. Upon the completion of the project, the DM will archive two copies of the sample tracking database and move each to a separate secure storage facility.

4.4.3.2 **Field Data Collection** Field data and sample collection will be streamlined by the use of hand-held, pen-based field computers and preprinted sampling labels (printed using the sample tracking database). The field computer will download information on each sample to be collected during an event from sample tracking prior to going out in the field. This information will be incorporated into a field sample form in which additional sampling information is entered into the electronic forms. A global positioning system will be attached to the computers to provide sample location information (i.e., latitude and longitude). Survey data provided by external sources (subcontractors or historical survey data), including offset variances and the reasons why such variances were required, will be compiled by the data manager for import into the project database. When sampling is completed, an electronic chain-of-custody form will be created, which will be sent electronically to the laboratory as well as printed out and sent with the samples. The information contained in the field computer will be downloaded into the sample tracking database on a semidaily basis or as data collection allows.

Data that does not have to be meshed with the analytical data (i.e., well construction, geological, and hydrological information) will be compiled into import database files for uploading into the project database on a daily basis or as permitted by data collection schedules. Unvalidated analytical data integrity (correct format and conforms to hard copy laboratory reports) will be verified upon the receipt of analytical data from the fixed-base laboratory. The unvalidated laboratory analytical data will then be meshed and verified with the sample tracking database data and placed into an import file for upload into the project database. A paper copy of the laboratory analytical reports, as well as electronic copies of the unvalidated analytical results, will be stored in a fire-safe vault. A separate paper copy of the laboratory analytical reports will be kept onsite in a locked cabinet to allow the DM access to the raw data. Upon the completion of the project, the DM will archive two paper copies of the laboratory analytical reports and electronic copies of the unvalidated analytical results. The DM will then move a set of each copy to a separate secure storage facility.

4.4.3.2 **Project Database** Import files from the sample tracking database will be uploaded into the project database on a daily basis or as permitted by data collection schedules and analytical data receipt. Data will be marked as uploaded when the DM has received documentation that the data has been uploaded correctly into the project database. Unvalidated data will be uploaded into the project database and will be validated in the project database upon the receipt of the validator's comments. Unvalidated analytical data will be marked as approved when the DM receives documentation that the validator's comments have been entered into the database. Database security will be provided by three levels of access with password verification. The project database will be backed up daily and the backups will be stored for 2 weeks in a fire-safe vault. Upon the completion of the project, the DM will archive two copies of the project database and move each to a separate secure storage facility.

5.0 DATA EVALUATION AND INTERPRETATION

5.1 DATA EVALUATION. Data evaluation is the process of organizing validated data into a working format and then reviewing it to confirm that project DQOs have been met. Data quality indicators of representativeness and completeness are measured to evaluate conformance to the DQOs.

5.2 DATA INTERPRETATION. Data interpretation is the process of reviewing the validated data and identifying the presence or absence of site-related chemical compounds in environmental samples collected during the investigation. This project has two phases of data interpretation: the first performed after completion of the DPT activities and the second after installation and sampling of permanent monitoring wells. In this investigation, the data interpretation process will be extended to incorporate elements of the baseline risk assessment and engineering evaluation to guide the sample collection process in the Phase II investigation. A summary report of the Phase I analytical results will present the data in graphical and tabular form and make recommendations for Phase II sampling. This summary report will present the technical justification for continuing with Phase II actions. The second (Phase II) report will be a comprehensive presentation of chemical data, data analysis, and recommendations for future activities.

5.3 PHASE I SUMMARY REPORT. The technical evaluation of Phase I results and recommendations regarding Phase II actions will be provided in the Phase I summary report. Included in this report is an interpretation of groundwater samples collected from Sites 4, 5, and 8. The Phase I report will be the decision point to determine if any delineation activities are required at any of these three sites. If delineation is required, the report will make recommendations of where and how many samples are minimally required to accomplish the objective. Justification for additional samples must meet one of following criteria: fulfills requirement of the AO, samples required for engineering evaluation, and samples required for baseline risk assessment. The process diagrams in Chapter 3.0 provide the basis for this analysis and the decision points for Phase II samples.

If no delineation is required, the report will recommend moving into Phase II, monitoring well installation. In this case, the Phase I report will provide proposed monitoring well locations that will be reviewed by SOUTHNAVFACENGCOM and MSDEQ.

The Phase I report will also review the groundwater information collected at downgradient locations from Sites 1, 2, 3, and 7. If those samples indicate that dioxins in groundwater are below action levels set by MSDEQ, then recommendations will be made for permanent downgradient monitoring wells at those sites.

CHAPTER 6.0

6.0 PROJECT SEQUENCE

6.1 PROJECT SEQUENCE. Activities related to the GWMP follow both parallel and sequential tracks with other activities to reach project objectives. A schedule depicting these activities is shown on Figure 6-1.

6.1.1 Review and Approval of the Groundwater Monitoring Plan The draft GWMP will be delivered to the regulatory agency, MSDEQ, for review and approval. Review comments will be addressed in the final GWMP. The plan becomes final after the MSDEQ comments are addressed.

6.1.2 Contract Award The contract award process will include the preparation of a plan of action to implement these groundwater monitoring activities, which will be the basis for contract negotiations. When contract negotiations have been completed, a notice to proceed will be issued that will allow preliminary activities to begin.

6.1.3 Preliminary Activities Mobilization tasks must be completed, prior to the initiation of field activities, to ensure efficient field sampling events. The project team will prepare specifications to initiate procurement of subcontractors and vendors for specialized services and equipment. Anticipated items for procurement include a drilling contractor, analytical laboratory, and surveying contractor. Standard items for mobilization will be through the contractor's program office with individual specialized items being coordinated through the field operations leader and task order manager.

6.1.4 Phase I Activities The activities planned for Phase I includes groundwater sample collection at Sites 4, 5, and 8 where known or suspected dioxin-contaminated groundwater exists. The focus at these three sites will be to complete a rough identification and delineation, if necessary, to install permanent monitoring wells. Groundwater samples will be collected at downgradient locations at Sites 1, 2, 3, and 7. The focus of sample collection at these four sites will be to screen the downgradient locations prior to installation of permanent wells. The sample collection in Phase I is at locations identified through the conceptual model process and will be followed by a Phase I summary report.

In addition to the sampling activities, the important interaction between the surficial aquifer and surface water at Sites 4 and 5 will be investigated. A stream and surficial aquifer monitoring station will be installed at both sites. Gaining an understanding of the interaction between surface water and groundwater will be crucial for developing monitoring plans beyond the scope of this investigation.

6.1.5 Phase I Summary Report The technical evaluation of Phase I results and recommendations regarding Phase II actions will be provided in the Phase I summary report. This report will include the interpretation of groundwater samples and recommendations for Phase II activities. If delineation is required, the report will make recommendations of where and how many samples are minimally required to accomplish the objective. Otherwise, the report will propose the locations of the permanent monitoring wells to be installed in Phase II.

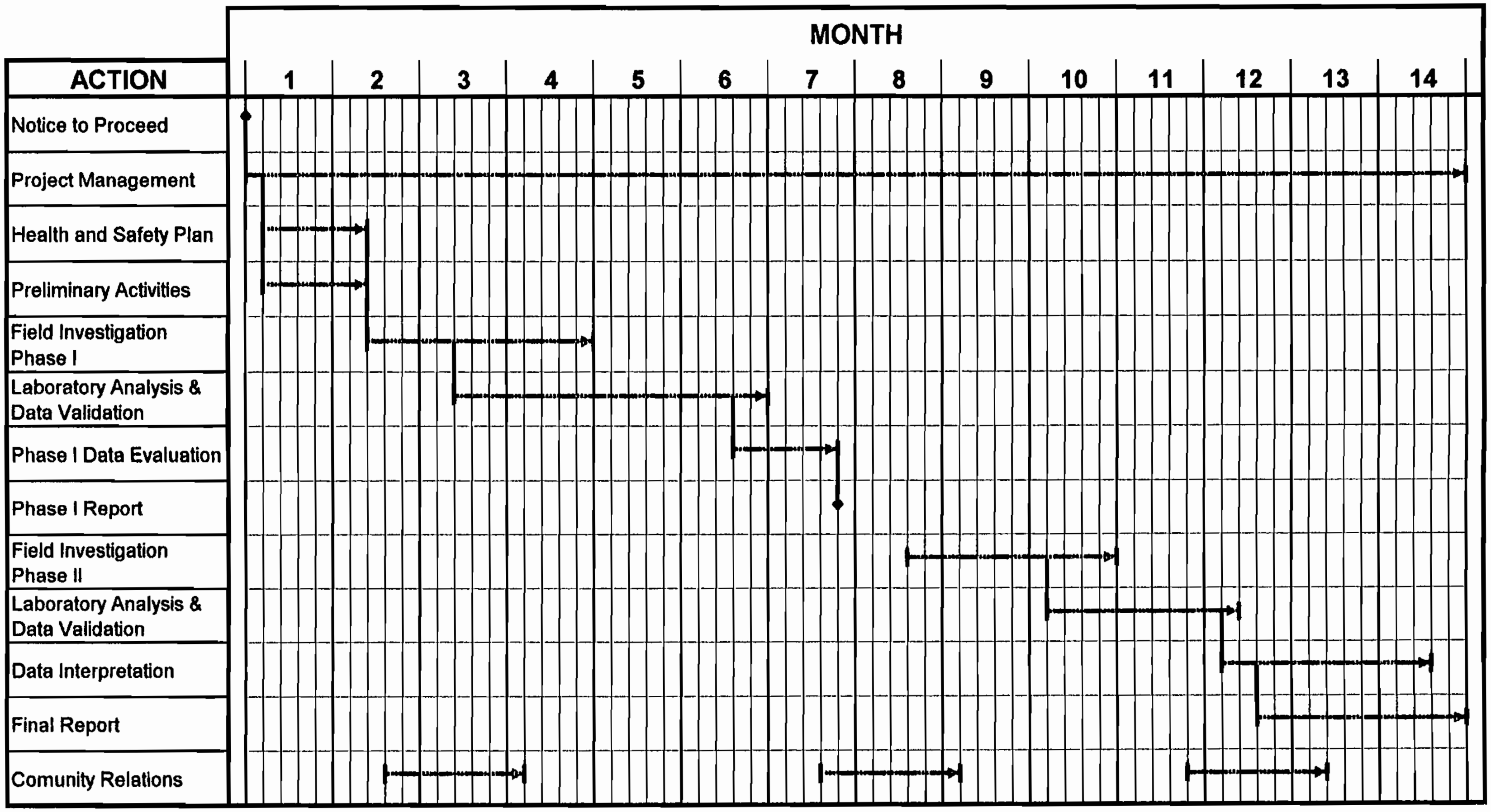

FIGURE 6-1

SCHEDULE

GROUNDWATER MONITORING PLAN

NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

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6.1.6 Phase II Activities Phase II activities will follow the Phase I summary report. Based on the recommendations of the summary report, Phase II activities may be performed to meet future engineering requirements or the needs of the AO. The primary activities occurring during Phase II will be the installation and sampling of permanent monitoring wells, and the collection of hydrologic data. The focus of Phase II activities include the installation and sampling of permanent monitoring wells.

6.1.7 Groundwater Monitoring Plan Report The final GWMP Report will present the results and findings from both phases of the activities. A comparison of the requirements of the AO and the results of the field investigations will be provided to demonstrate compliance with the AO.

REFERENCES

REFERENCES

ABB Environmental Services, Inc. (ABB-ES), 1993a, MILCON Construction Site Assessment, Project P-745, Technical Memorandum, Naval Construction Battalion Center, Gulfport, Mississippi: prepared for Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), Task Order No. 096, Contract No. N62467-89-D-0317, September.

ABB-ES, 1993b, Remedial Investigation and Feasibility Sampling and Analysis Plan, Vols. I. and II, Naval Construction Battalion Center, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 096, Contract No. N62467-89-D-0317.

ABB-ES, 1994a, Technical Memorandum No. 1, Former Herbicide Orange Storage Area, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 092, Contract No. N62467-89-D-0317.

ABB-ES, 1994b, Free-Phase Product Assessment Report, Site 6, Fire-Fighting Training Area, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 092, Contract No. N62467-89-D-0317.

ABB-ES, 1995a, Letter Report: Basewide Groundwater, Sediment and Surface Water Study, Naval Construction Battalion Center, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 096, Contract No. N62467-89-D-0317.

ABB-ES, 1995b, Technical Memorandum No. 2, Former Herbicide Orange Storage Area, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 092, Contract No. N62467-89-D-0317.

ABB-ES, 1995c, Technical Memorandum No. 3, Former Herbicide Orange Storage Area, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 092, Contract No. N62467-89-D-0317.

ABB-ES, 1995d, Technical Memorandum No. 4, Former Herbicide Orange Storage Area, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 092, Contract No. N62467-89-D-0317.

ABB-ES, 1995e, Technical Memorandum No. 5, Former Herbicide Orange Storage Area, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 092, Contract No. N62467-89-D-0317.

ABB-ES, 1995f, Letter Report: Surface Soil Sampling Field Program and Analytical Results for Area A, Former Herbicide Orange Storage Area, Naval Construction Battalion Center (NCBC), Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 092, Contract No. N62467-89-D-0317.

ABB-ES, 1995g, Letter Report: Interim Removal Action - 28th Street Road Construction, NCBC, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 096, Contract No. N62467-89-D-0317.

ABB-ES, 1995h, Letter Report: Removal Action Technical Support, Contaminated Sediment and Surface Soil and Analytical Results in 28th Street Roadway, NCBC, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 096, Contract No. N62467-89-D-0317.

ABB-ES, 1996a, Technical Memorandum No. 6, Former Herbicide Orange Storage Area, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 092, Contract No. N62467-89-D-0317.

ABB-ES, 1996b, Onsite Delineation Workplan, Administrative Orders No. 3193-96 and No. 3194-96, NCBC Gulfport, Mississippi: prepared for SOUTHNAVFACENG-COM, Task Order No. 096, Contract No. N62467-89-D-0317.

ABB-ES, 1996c, Offsite Delineation Workplan, Administrative Orders No. 3193-96 and No. 3194-96, NCBC Gulfport, Mississippi: prepared for SOUTHNAVFACENG-COM, Task Order No. 096, Contract No. N62467-89-D-0317.

ABB-ES, 1996d, Addendum to Delisting Petition, Naval Construction Battalion Center, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 092, Contract No. N62467-89-D-0317 (in progress).

ABB-ES, 1996e, Letter Report: Soil and Sediment Dioxin Triplicate Study, Naval Construction Battalion Center, Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Contract No. N62467-89-D-0317.

ABB-ES, 1996f, Site Management Plan, NCBC Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 096, Contract No. N62467-89-D-0317.

ABB-ES, 1996g, Interim Corrective Measures Workplan, NCBC Gulfport, Mississippi: prepared for SOUTHNAVFACENGCOM, Task Order No. 096, Contract No. N62467-89-D-0317.

ABB-ES, 1996h, Field Method Sheets, Tallahassee, Florida.

American Society for Testing and Materials (ASTM), 1985, Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants: D 421-85, September.

Arienti, M., L. Wilk, M. Jasinski, N. Prominski, 1988, Dioxin-Containing Wastes Treatment Technologies, Pollution Technology review No. 160: published by Noyes Data Corporation, Park Ridge, New Jersey, U.S.A.

EG&G Idaho, Inc., 1987, Naval Construction Battalion Center Trail Burn Report, Idaho Falls, Idaho, June 16.

EG&G, 1988, Comprehensive Soil Study of Naval Construction Battalion Center, Gulfport, Mississippi.

Hazardous Waste Remedial Action Program (HAZWRAP), 1991, U.S. Air Force Installation Restoration Program, Summary Report Remedial Characterization and Soil Remediation Technology Review for the Former Herbicide Storage Site at the Naval Construction Battalion Center, Gulfport, Mississippi: prepared for U.S. Air Force/CEVV under contract DE-AC05-84OR21400.

Mississippi State Department of Environmental Quality (MSDEQ), 1996, Administrative Orders No. 3193-96 and No. 3194-96, February 14.

Morrison Knudson, 1996, Workplan for Sites 4, 5, and 8: prepared for SOUTHNAVFACENGCOM, Work Order 4324, Contract Number N62467-93-D-1106, North Charleston, South Carolina.

Naval Energy and Environmental Support Activity (NEESA), 1985, Initial Assessment Study of NCBC Gulfport, Mississippi, NEESA FAC-112/FAC-06, Port Hueneme, Georgia.

NEESA, 1988, Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program, Naval Energy and Environmental Support Activity, NEESA 20.2-47B, Port Hueneme, California.

Occupational and Environmental Health Laboratory, 1979, Initial Herbicide Orange Monitoring Program.

Shows, 1970, Water Resources of Mississippi, Bulletin 113, Mississippi Geological, Economic and topographical Survey, Jackson, Mississippi, pp. 106-121 and 151-160.

U.S. Environmental Protection Agency (USEPA), 1983, Methods for Chemical Analysis of Water and Wastes, 600/4-79-02, March.

USEPA, 1986a, Research Development and Demonstration permit issued in July.

USEPA, 1986b, Test Methods for Evaluating Solid Waste, Volume 1B: Laboratory Manual Physical/Chemical Methods, 3rd Edition, Office of Solid Waste and Emergency Response, Washington, DC, November.

USEPA 1989, Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and Dibenxofurans, March.

USEPA, 1992, Contract Laboratory Program, Statement of Work for Organic Analysis, USEPA Document No. OLC01.6, October.

USEPA, 1991b, Standard Operating Procedures and Quality Assurance Manual, USEPA Region IV, Environmental Compliance Branch, Environmental Services Division, Athens, Georgia, February.

USEPA, 1991c, National Functional Guidelines for Organic Data Review, Office of Energy and Remedial Response, June.

REFERENCES (Continued)

USEPA, 1994a, Title 40 CFR, Part 264, Appendix IX, Groundwater Monitoring List: July.

USEPA, 1994b, Guidance for the Data Quality Objectives Process, EPA QA/G-4, USEPA Quality Assurance Management Staff, Washington, D.C., September.

U.S. Soil Conservation Service, 1986, Urban Hydrology for Small Watersheds, revised Technical Release 55, U.S. Department of Agriculture, Washington, D.C.

Versar, 1990, Ground-Water Monitoring Program Plan, Naval Construction Battalion Center, Gulfport, Mississippi, November 20.